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Devitalized (Dead) Teeth.—*Novitzky.*

A New Continuous Gum Set.—*Nies.*

The Relative Toxicity of Cocaine and Novocaine.—*Roth.*

Dental Training for the Navy Hospital Corps.—*Connely.*

The Effect of Emetine on the White Blood Corpuscles.—*Schlomovitz.*

A Simplified Method of Removable Bridge Work, Using the Yirikian Attachment.—*Levy.*

Electrolytic Medication (Physiological and Dental Aspects.)—*Pond, Price.*

The Relation of the Dental Profession to the Government.—*Editorial.*

American Dentists Awarded Legion of Honor.—*Editorial.*

National Dental Association Meeting, Chicago, August 5-9, 1918

CONTENTS

Page

Greene Vardiman Black Memorial.....Frontispiece

ORIGINAL COMMUNICATIONS.

Devitalized (Dead) Teeth.
By Josef Novitzky, D. D. S..... 555

A New Continuous Gum Set.
By Frederick H. Nies, D. D. S..... 565

The Relative Toxicity of Cocaine and Novocaine.
By George B. Roth, A. B., M. D..... 574

Dental Training for the Navy Hospital Corps.
By Willard Connely, U. S. N. R. F..... 582

The Effect of Emetine on the White Blood Corpuscles.
By Benj. H. Schlomovitz, B. S., M. A..... 588

A Simplified Method of Removable Bridge Work, Using the Yirikian Attachment.
By Joseph M. Levy, D. D. S..... 591

THE RESEARCH DEPARTMENT.

Electrolytic Medication (Physiological and Dental Aspects).
By Samuel E. Pond and Weston A. Price..... 601

EDITORIAL DEPARTMENT.

The Relation of the Dental Profession to the Government..... 629
American Dentists Awarded Legion of Honor..... 631
The High Heart..... 632

ARMY AND NAVY.

Legislation for Increased Rank for Medical Officers..... 634
General Gorgas's Indiscretion..... 635
Army Medical Corps Legislation..... 635
Universal Training Favored..... 636
Drafted Men Show Physical Defects..... 636
War Department Opposing Owen Bill..... 636
Army Dental Corps..... 637
Letter from Patriotic Dentist..... 638
Shoot the Spies!..... 638
Army Medical Department..... 639
Salute the Flag..... 639
Against Medical Corps Legislation..... 640
Additional Dentists for Divisions..... 640
Shall Venereal Disease Menace the Nation?..... 640
New Head for Army Medical Corps..... 642
Reconstructing Disabled Men..... 643
Social Hygiene Division..... 644
New Naval Hospital Facilities..... 644
American Medical Officers Under Fire..... 644
Medical Corps Increase..... 645
Naval Dental Corps..... 645
Dental Corps Orders from War Department..... 645

Relief Fund Department..... 647

ITEMS OF INTEREST.

Novocain-Suprarenin Solution..... 649
Ideals and Idealism.
By John E. Gurley, D. D. S..... 650
Free Dental Clinic at Aberdeen, S. D..... 651
Remove that Foolish Tax!..... 651
Report of Tabulating Committee of National Association of Dental Examiners..... 652
Dental Plate Holder.
By A. N. Bessesen, M. D..... 655
The Dental Society..... 656

DEATHS.

Dr. J. W. Parsons..... 657
In Memory of Our Dead..... 657

ANNOUNCEMENTS.

National and State Societies Meetings.—West Virginia State Board of Dental Examiners.—Meeting of Montana State Board of Dental Examiners.—Nebraska Board of Dental Secretaries.—South Dakota State Board of Dental Examiners.—Board of Dental Examiners State of Wyoming.—Maine Board of Dental Examiners.—South Carolina State Board.—Board of Dental Examiners of the District of Columbia.—Utah State Dental Society.—California State Meeting.—The American Academy of Oral Prophylaxis and Periodontology.—Notice.—National Dental Association—Sixtieth Anniversary of Organized Dentistry and Dedication of Black Memorial.—Psi Omega Fraternity.—Tufts College Dental School.—Preparedness League of American Dentists.—North Dakota State Board of Dental Examiners 659-666

GREENE VARDIMAN BLACK MEMORIAL

A Memorial from The National Dental Association. To be Dedicated at the 60th Anniversary Meeting to be held in Chicago August 5-9, 1918

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Original Communications.

DEVITALIZED (DEAD) TEETH.

By Josef Novitzky, D. D. S., San Francisco, Cal.

AT THE present time dental students are particularly interested in methods of treating devitalized teeth. They are taught that devitalized teeth should be retained in the jaws to serve as organs of mastication. They are led to believe that the dentin of a devitalized tooth can be so sterilized as to prevent suppurative and putrefactive changes from taking place in the tooth and in the surrounding parts.

Hence dentists freely devitalize teeth, treat the devitalized teeth by various methods, and send the patients away assured that the devitalized teeth are practically as good as vital ones. There is no mention of the fact that devitalized teeth are apt to be harmful when retained in the jaws.

Physicians realize that many metastatic lesions are secondary to virulent pathogenic organisms in the jaws. To these organisms may often be traced asthma, septic bronchitis, pneumonia, skin eruptions, rheumatic conditions of joints, muscles, and nerves, heart and kidney lesions, chronic toxemias, bacteremias, and anemias. But dentists do not realize that virulent pathogenic organisms in the jaws are usually due to the retention of devitalized teeth. The conditions in the jaws can not be seen in the ordinary examinations of teeth; and the minds of dentists are on things other than the hidden pathogenic organisms of the jaws and the future health of the patients.

A typical case is the following:[1] This

[1] Case No. 278A.

woman had her breast removed seven years before. Two years after the removal there was recurrence of the growth. This was followed by operation. One year ago, an induration was noticed just above the clavicle on the affected side. There was also an indurated mass under the angle of the jaw on the operated side. This was thought to be malignant. The removal of the lower 1st and 2nd molars with quite an extensive amount of carious process and also of septic bicuspids in the upper jaws, resulted in a complete disappearance of the indurations; resolution being encouraged with moist heat. The patient has also noticed that after the jaw surgery, the arm of the affected side, no longer swelled and stiffened. This patient had almost decided to submit to a radical operation for a malignant growth.

The necessity of the prompt removal of dead teeth and necrosed bone from the jaws may be seen by the following case. Unobserved by the patient and by his physician injury to the heart was undoubtedly being caused by conditions of the jaw. The cause of the injury was removed by operation; but the injury to the heart had been done. The removal of the cause was too late.

The patient, aged 47 years, sought my advice because of a toothache.[2] The average case that presents is referred for aches and pains in remote parts that are thought to be due to dental origin. Röntgen ray examination indicated evidence of suppurative destruction in the apical region of the right upper 1st molar. Blood pressure examination showed a systolic pressure of 195 and a diastolic pressure of 140. Urinalysis showed casts and albumen. These findings were confirmed by the medical attendant.

The patient apparently was in the best of health and made no mention of illness or pain aside from the tooth ache.

[2]Case No. 351A.

At operation on the upper molar the outer plate was dissected away from the buccal roots. This exposed a large cavity filled with offensive odorous granulations. A necrotic opening was found leading into the antrum. Granulations from the necrosed root protruded into the cavity. The unhealthy parts were thoroly removed and the mouth wound sutured.

Bacterial growth from these granulations was reported by Dr. Knapp of St. Luke's Hospital, San Francisco, to be a pure strain of a short chain streptococcus of the viridans type.

Three weeks after operation the wound was nicely healed and the patient's weight had increased about seven pounds. Blood pressure examination showed a systolic pressure of 180 and a diastolic pressure of 125. Urinalysis was negative.

This marked improvement followed the jaw surgery, as no medication of any kind, outside of free drinking of mildly alkaline waters had been undertaken.

Some three months after the operation the patient was called upon to exert himself over a period of some days, during which he was on duty day and night with little sleep. While on duty he was taken ill with a severe pain in the heart and died a few hours later in spite of the best medical help.

Experience with similar cases has led to the conclusion that the injury to the heart had been caused by the condition of the jaw previous to the operation. Injury to parts of the body remote from the mouth is commonly due to the practice of devitalizing teeth, and treating and retaining dead teeth in the jaws.

Whether a medical examination of the body does or does not show deviations from the normal, injury of more or less degree undoubtedly takes place.

Devitalized teeth in which putrefactive changes have taken place should be

removed from the jaws not by the ordinary 'pulling' or extraction but by a surgical dissection.[3]

Under local anesthesia the gums and the periosteum may be cut loose and stripped down along as much of the length of the jaw as is necessary to gain free space for operating. But generally it is sufficient to raise and pull back a triangular flap with the apex at the gingival margin of the affected tooth. Thus the outer plate of bone for the entire root length is exposed.

Then the outer plate of bone over the involved root is removed with the chisel so as to expose the cancellous bone with the tooth root in position. In many cases the root may be used as a guide in following up minute drainage ways into neighboring canals or cavities.

Now, since the region is blocked off by sterile sponges and hemorrhage is under control, specimens of granulation tissue and pus may be isolated.

The table on the following pages indicates some of the growths obtained during operation, as well as the conditions preceding the operation and the results of it.

These few selected cases should help to convince those who have had no direct experience with this kind of work of the seriousness of the dead tooth evil. They indicate with no uncertainty the necessity for operation rather than mere 'pulling' and also the hopelessness of attempting to embalm and retain dead teeth in the jaws with immunity from systemic ills.

If a cavity is found under the roots of the tooth, the tooth and the alveolar septum are removed with the chisel. The inner plate of the jaw is left intact except in a few cases in the upper jaw which involve the antrum. In such cases enough of the inner plate of the upper jaw is removed to allow the inner flap of mucous membrane and periosteum to be pulled over to meet the outer. Injury to the inner plate should be avoided whenever possible, because when both plates are removed, bone regeneration takes place more slowly in the inner plate than in the outer. Also some deformity may follow the removal of both plates.

Antrum incisions may be sutured immediately after the operation because drainage takes place thru the natural ostium into the nose. Unless hemorrhage is excessive gauze packings are unnecessary. If the cavity must be irrigated, a cannula may be inserted thru the flap from the mouth or thru the thin plate of bone under the inferior turbinate. When antrum pathology is due to a dead tooth, the method of approach from the mouth allows direct vision and permits the opening to be extended with minimum shock to the patient. It retains the nasal wall intact and thus prevents the accumulation of mucous in the cavity thru an unnatural opening from the nose.

The surgical dissection outlined above renders certain a clean removal of the diseased area, because it offers a clear view of the operative field. It results in little inconvenience and no damage to the patient. After the operation alveolar

[3]Articles mentioning this technic will be found in:

Pacific Dental Gazette, May, 1915.

Cal. State Journal of Medicine, Nov., 1915.

Pacific Dental Gazette, Feb., 1917.

American Journal of Surgery, Aug.-Sept., 1917.

Journal of the Cal. State Dental Association, Nov.-Dec., 1917.

Dental Items of Interest, Jan., 1918.

This technic was advocated before the:

S. F. District Dental Society, March, 1915.

Surgical Section of the S. F. County Med. Society, May, 1915.

Sonoma County Dental Society, June 5, 1915.

Panama Pacific Dental Congress, August, 1915.

St. Luke's Hospital Diagnostic Section, December. 1916.

Surgical Section of the S. F. County Med. Society, Jan., 1917.

S. F. District Dental Society, Oct. 8, 1917.

Surgical Section of the S. F. County Med. Society, Oct. 16, 1917.

A clinic for the Alameda County Dental Society, at Fabiola Hospital, Dec. 8, 1917.

Case No. and Date of Examination	Clinical History	Mouth and Röntgen-ray Examination.	Operation and Date.	Tissue or Specimen.	Bacteriological Findings.	Culture Media	Result of Operation
260A March 13, 1916	Underweight—weighed 103 lbs. before operation. Palpitation of heart at least exertion. Sweating of back and extremities had appeared a few months before operation. Myositis of muscles of back and arms. Extreme fatigue and mental depression. Observation and restraint was necessary.	14 dead teeth in various stages of putrefaction. Röntgen-ray examination indicated extensive pathological involvement of cancellous bone.	March 18, 1916. The involved teeth and underlying process was removed by dissection at three separate operations Odor was marked. Offensive graulations were found to constitute the greater part of the inner structure of the mandible.	Section shows well defined bands of connective tissue, some of which shows a relative large amount of collagen, indicating that it had been formed for a considerable period of time. There were also present in the section varying stages from this well defined fibrous tissue to early granulation tissue. The picture in the granulation tissue is quite regular, the blood vessels being evenly distributed and well formed, with definite endothelial lining. The space between the blood vessels shows considerable round cell infiltration and some polymorphs. Microscopical diagnosis: Granuloma.	Streptococcus pyogenes and an occasional colony of white staphylococcus in sub cultures.	Broth	Sweating had entirely ceased about 1 week after operations. Patient gained 17 lbs. in 5 months. Eight months after operation weight was 123 lbs., a gain of 20 lbs. Heart palpitation. muscular pain, fatigue and mental depression entirely disappeared and has not returned up to 1 year and 8 months after operation.
260A March 13, 1916	Same case as preceding.	Same case as preceding.	March 25, 1916.	Control. Specimen from normal part of cancellous bone of maxilla.	Tube and subcultures remained sterile.	Broth	Same case as preceding.
333A Feb. 21, 1917	Patient easily fatigued. Had "grippe" several times each year.	Lower right 2d and 3d molars and 2d bicuspid dead, ankylosed, discolored and offensively odorous. Röntgen-ray examination indicated large areas of disintegrated bone involving apical region. The first molar region was also involved. This tooth had been extracted many years ago. Patient stated that it was "abscessed" before removal.*	March 2, 1917. Gums and periosteum retracted. Outer plate of mandible removed over root length of involved region. Necrosed bone and granulations removed with curette. Disorganized area removed was 1½ inches in length.	Granulation tissue areas of purulent infiltration.	Streptococcus veridans, staphylococcus pyogenes albus, and staphylococcus pyogenes aureus	Broth Ascites dextrose broth.	Three pounds gain in weight. Excess fatigue has not been noticed since. No "grippe" to date, 10 mos. after operation.

*Attention was first called to the dangers of septic retention following the extraction of dead teeth, in the Pacific Dental Gazette, May, 1915. Novitzky: Radiograph in Dentistry.

vitzky: Radiograph in Dentistry.

Case No. and Date of Examination	Clinical History	Mouth and Röntgen-ray Examination.	Operation and Date.	Tissue or Specimen.	Bacteriological Findings.	Culture Media	Result of Operation
321A Dec. 29, 1616	No abnormalities.	Right lower 2nd bicuspid and 1st molar teeth dead. Röntgen-ray examination indicated the presence of a large area of disintegrated bone, involving apical region of these teeth.	Jan. 3. 1917. Parts exposed by dissection of outer plate over lower part of roots. Root ends amputated. Offensive granulations and some pus removed.[4]	Tissue. Sections show fibrotic structure with endothelial leukocytic and large and small areas of round cell infiltration. Certain of these areas are definitely circumscribed by densely organized fibrous tissue. Granulation tissue. Areas of purulent infiltration.	Short chain streptococci (hemolytic). An occasional colony of white and yellow staphylococci.	Broth Ascites dextrose broth.	Patient has gained some weight. (This was to be expected independent of the surgery age—19).
355A June 25, 1917	Temperature 99.4. Loss of weight. Fainting spells. No appetite.	Dead teeth in upper and lower jaw. Röntgen-ray examination indicated small areas of root ends.	July 2, 1917. Removal of dead teeth and involved structure by dissection.	Granuloma. Root apices.	Tissue specimen from apical region showed staphylococcus pyogenes albus and short chain streptococcus pyogenes. The root ends showed a pure culture of staphylococcus pyogenes albus.	Broth	Gained 1 lb. a few days after operation. Temperature still higher than normal. Appetite still poor. Fainting spells have ceased. Patient appears slightly better.
315A Nov. 9, 1916	Lichen planus of some years' standing.	3 lower molars dead. Röntgen-ray examination indicated some pathological involvement of apical region.	Nov. 11, 1916. Teeth were dissected out. Odor was noticed. Granulations were found in apical region.	Exudate from dead root apices.	First tubes remained sterile. Second tubes showed well developed colonies after 48 hours with greenish halo. Short chain streptococcus and bacillus bearing the morphylogical characteristics of influenza bacilli. Further attempts to develop and separate these organisms failed.	Glucose broth and glucose ascites agar. Glucose blood agar.	Patient, a physician, reports that the skin affection has practically disappeared.
240A. Jan. 24, 1916	Tendo synovitis of finger joints. Elbow ankylosed.	Many dead teeth. Röntgen-ray examination indicated one tooth to be ankylosed. Some destruction of process was indicated in others.	Feb. 15, 1916. Ankylosed tooth was removed by dissection, also one of the bicuspids. A large granuloma was found at root end of the bicuspid.	Granuloma.	Staphylococcus albus. A short chain streptococcus producing green on blood plates. This streptococcus did not form, acid on the various sugar media.	Broth	No improvement. Several dead teeth still in the jaw.

[4]Root amputation is no longer advocated by the author. Novitzky: Technic for the Removal of Dead Teeth, Journal of the Cal. State Dental Association, Nov. and Dec., 1917.

Case No. and Date of Examination	Clinical History	Mouth and Röntgen-ray Examination.	Operation and Date.	Tissue or Specimen.	Bacteriological Findings.	Culture Media	Result of Operation
353A June 15, 1917.	Discharge from nostril.	Dead tooth with antral[5] involvement.	June 25, 1917. Tooth removed by dissection. Floor of antrum found perforated and necrotic. Granulations from root end found growing into cavity.	Granuloma.	Streptococcus of viridans type. Subcultures on blood agar showed fine colonies producing green pigment.	Broth Blood agar.	Nasal discharge has ceased. Patient gained 5 lbs. in weight 3 weeks after operation.
311A Sept. 27, 1916	Patient seven lbs. underweight. Patient tired out. Face badly swollen. Acute dental abscess.	Necrotic molars and bicuspids. Röntgen-ray examination indicated extensive involvement of right antrum.	Nov. 1, 1916. Incision beginning at gingival margin of right upper 3rd molar to right cuspid. After soft parts were retracted, teeth and necrosed bone were removed. The antrum was found in a hopelessly necrotic condition. Osseous walls of cavity and floor of orbit had become obliterated (not malignant). The cavity was found filled with polypoid granulations in grape like clusters.	Tissue sections show a fairly compact fibroreticulum without inflammation elements or unusual cell proliferations.[6]	All cultures show an almost identical growth consisting principally of saprophytic mouth bacteria. None of the cultures showed streptococci. (Continued).	Broth Glucose broth.	Patient feels better. Acute symptoms have disappeared following operation. Patient has lost 5 lbs. more to date, one year and 3 months after operation.
275A April 17, 1916	Patient in helpless condition. Hips, both knees and both elbows ankylosed. Extremities swollen and twisted. This was of some years standing.	Mouth edentulous. Röntgen-ray examination indicated areas of disintegrated structure in the jaws.	May 9, 1916. Horseshoe incision in lower and upper jaw along the entire ridge. Necrosed bone and collection of yellow pus found in different regions of both jaws. Soft structures fully retracted. Exploratory opening into left antrum. Cavity was found filled with a thick mucoid material.	Examination of mucoid material. Smears show mucous, few degenerated leucocytes. No bacteria. Cultures no growth.	A specimen sent to a second pathologist. Report of short chain streptococcus pyogenes.	Broth.	No improvement.

[5]Dead upper molars are frequently found to have ways for drainage to and under the antral membrane. Dissection under Novocain anesthesia will usually demonstrate this.

[6]The discrepancy between clinical and operative findings with bacteriological and histological findings, has frequently been noted by the author.

Case No. and Date of Examination	Clinical History	Mouth and Röntgen-ray Examination.	Operation and Date.	Tissue or Specimen.	Bacteriological Findings.	Culture Media.	Result of Operation
357A July 2, 1917	Fatigue.	Röntgen-ray examination showed penetration of infection into several vital tooth sockets. Suppurative destruction of joint and surrounding osseous structures. Two large lateral abscesses of vital roots (metastatic). Two dead teeth with apical infection and destruction.	July 23, 1917. Involved teeth and pathology removed by dissection.	Granulation tissue from apical and lateral abscesses.	Staphylococcus pyogenes albus and a diphtheroid bacillus.	Broth.	Gained four lbs. in weight 3 weeks after operation. Feels better. No fatigue noticed.
242A Jan. 27, 1916	Fatigue. Right knee joint painful. Right trapezius muscle "stiff" for the last four months. Bad taste in mouth. Blood clots and discharge from right nostril.	Right upper first and second molars dead. Bore unmistakable evidence of putrefactive changes. Röntgen-ray examination indicated antral perforation.	March 16, 1917. Teeth dissected out. Large mass of granulations found protruding into antrum from root ends.	Granuloma	Streptococcus pyogenes. Bacillus of Friedlander. Micrococcus catarrhalis and staphylococcus pyogenes albus.	Broth.	Much improvement in clinical symptoms. Discharge from nostrils has not returned up to 8 mos. after operation. Myositis has not returned.
242A Jan. 27, 1916	Same case as preceding.	Left upper first molar findings were similar to the right side.	April 6, 1917.	Granuloma	Streptococcus mucosus. Staphylococcus pyogenes albus.	Broth.	Same case as preceding.
65A April 15, 1910	None.	Pulp death following the placing of a porcelain jacket crown on a vital incisor.	April 13, 1917. Root amputated.	Exudate from dead root apex.	Gram positive cocci occurring in pairs and moderately long chains. Subcultures on blood agar showed numerous fine colonies of Gram positive diplococci producing green pigment and a few colonies of Gram positive micrococci. The latter producing white pigment on plain agar. Diagnosis: Streptococcus of viridans type. Albococcus.*	Broth. Blood agar.	

*Bacteria probably penetrated from the mouth by way of the dental tubuli.

Case No. and Date of Examination	Clinical History	Mouth and Röntgen-ray Examination.	Operation and Date.	Tissue or Specimen.	Bacteriological Findings.	Culture Media.	Result of Operation
225A Oct. 21, 1915	Multiple arthritis of some years standing. Mental unstability.	Dead, ankylosed teeth. Some involvement of apical structure.	Nov. 24, 1915. Removal by dissection.	Exudate from dead root apices.	Streptococcus pyogenes, staphylococcus albus and diplococcus of the diphtheria group.	Broth.	Considerable mental improvement and temporary improvement in a few joints. Relapse six months later.
307A Sept. 14, 1916	Severe pain in back. Patient unable to lift any weight for last five years due to "cramping" of muscles. Pain in region of liver. Treated for "gall stone pain."	Right lower 1st molar dead. Has bothered patient off and on for the last 3 years. It was devitalized 7 years ago. Pus draining into the mouth from the gingival margin of this tooth. Röntgen-ray examination showed what appeared to be a cavity in the mandible as large as a 50 cent piece, smoothly outlined in places, in other places very irregular.	Sept. 25, 1916. The part was well exposed by a two inch incision thru the bucal gums. The tooth and a mass of foul smelling granulations with small islands of discolored process was removed with the curette.	Fibroblastic proliferation. Endothelial and leucocytic infiltration. No indication of tubercle, bacterial or histological. Chronic inflammation.	Predominant colonies of staphylococcus albus. A few colonies of micrococcus catarrhalis. A few chains of streptococcus in water of condensation. Predominance of concomitant organisms precluded determination of type.	Broth.	Five weeks after operation patient gained 18 pounds in weight. Myositis has disappeared. No more "gall stone pain" up to 1 year and 3 months after operation.
143A Sept. 25, 1911	None.	Left upper bicuspid dead. Area at root apex.	Dec. 22, 1914. Removing by dissection root end and a small round mass in the apical region. This was attached to the root by a fibrous pedicle.	Suspicious. A second pathologist identified this as sarcoma.	None.	None.	No recurrence of growth to date, 3 years after operation.

process will regenerate in the greater part of the operative wound.

The areas of disintegrated bone or new growth tissue at the root ends of dead teeth can not be adequately treated thru the root canals of the teeth. Hundreds of patients examined a few years after such treatment showed very clearly that the treatment was inadequate. Areas of disintegrated bone cannot be drained and cured thru the root canals of the dead teeth.

The old method of 'pulling' or extracting dead teeth in which putrefactive changes have taken place, commonly, will not suffice to remove all of the diseased area. Blind curetting after extraction may be helpful or it may be harmful, depending on whether or not all septic granulations and disintegrated bone are removed. I have seen many serious results following incomplete removal of such structure. Blind curetting is at best uncertain, and the location of septic areas are often such that curetting can not reach them without opening of the parts to direct access and vision. The free sweep of the curette in the deeper pathological cavity is impossible in many cases because the upper part of the septum separating the roots is still intact.

When dead teeth are extracted septic tissue is often retained in the jaws. Broken down alveolar process and granulations, unseen by the dentist who 'pulls' the tooth may cause systemic toxemias or bacteremias. In fact, the septic tissue retained after a single putrescent tooth is extracted may cause infective thrombosis and embolism following the opening of the facial veins and results in death.

Moreover, the dentist who extracts teeth will probably fail to discover such complications as antral perforations, necrotic antral walls, polypi, and pathological involvement of the canals which supply the nutrient arteries and nerves of the jaws.

Frequently after the extraction of a putrescent tooth the necrotic structure which is not removed causes a chronic low grade suppuration. This goes on perhaps for a number of years and causes extensive loss of alveolar process.

Before putrescent teeth are 'pulled' diagnosis by means of röntgenograms is not difficult. After the 'pulling,' if septic tissue remains in the jaw, a low grade suppuration may go on for several years unknown to the patient. When finally a heart lesion, a rheumatic joint, or some other direct result of the suppuration becomes apparent, diagnosis is extremely difficult. A röntgenogram may not indicate clearly the condition in the jaws because more or less eburnation has taken place in the alveolar process surrounding the septic area. Diagnosis can be made only by exploratory operation. Frequently diagnosis is too late, because in case of heart lesion, for instance, while the cause of the trouble may be removed from the jaw, the damage to the heart itself can not be removed.

We have attempted to show why dead teeth in which putrefactive changes have taken place should be dissected out, not 'pulled' or extracted.

It is natural now to ask whether it is possible to retain in the jaws dead teeth in which putrefactive changes will not take place. Various methods have been devised with the aim of sterilizing dead dentin so as to prevent putrefactive and suppurative changes from taking place in the tooth and the surrounding parts. The efforts of dentists today, in fact, seem to be directed toward the 'treatment' of dead teeth more than toward any other problem.

When the vital pulp has been removed from a tooth its blood supply has been cut off; and the tooth dentin dies. The dead tooth dentin containing approximately 28% of organic matter is subject to the laws of decomposition. Deleterious changes in this dead organic matter may be retarded. An area in the jaw filled with fibrous granulations and different strains of micrococci may be

rendered passive so far as acute symptoms are concerned. Absorption may be temporarily arrested from such an area and putrefactive changes may be retarded in the tooth itself.

But a few years after a tooth has been devitalized it will show evidence of putrefactive changes. I have examined hundreds of dead teeth treated by all the known methods of sterilization and embalming; and I have failed to find a single one which did not show clear evidence of putrefactive changes some years after devitalization. The color and the odor of the opened tooth would be enough to convince any one of the failure of the 'treatment' and 'cure.'

Therefore we may conclude that every devitalized tooth will in course of time become putrescent. And since this is true we must add that no tooth should be devitalized. The free devitalization of teeth is almost criminal.

When devitalization can not be prevented, putrefactive changes are bound to take place in the tooth itself and probably in the surrounding parts.

Immediately after devitalization only, may a dead tooth be extracted by the old method without danger to the patient. The dentist who finds it absolutely necessary to devitalize the tooth should extract the tooth immediately.

But if the devitalized tooth has remained in the jaw until putrefactive changes have taken place in it and probably in the surrounding parts, a röntgenogram may offer evidence of this. There may be drainage ways so minute that the röntgenogram will not disclose them. There may be perforations into neighboring cavities or canals which blind probing will not indicate. The cancellous bone may take up septic exudate.

Extraction in such cases will never offer a certain 'cure.' The cure demands the removal of dead teeth, necrosed bone, and pyogenic granulations thoroly. The thoro removal is possible only by means of the surgical dissection outlined above.

A NEW CONTINUOUS GUM SET.

By Frederick H. Nies, D. D. S., Brooklyn, N. Y.

(Read before the National Dental Association at Its Twenty-first Annual Session, New York City, N. Y., October 23-26, 1917.)

THE continuous gum set is a denture that should enlist the interest of men who are not satisfied with pink vulcanite when matchless porcelain is at their disposal. What pink vulcanite gum can compare in life-like appearance with the delicate flesh colored pinks of glazed porcelain? The continuous gum set is too artistic a piece of work to pass away, but despite its obvious beauty its natural appearance and its cleanliness it has been passing.

What are the causes of its decline and can these causes be remedied? The principle cause of the decline of the continuous gum set is largely due to the fact that we find it more profitable to do something else. We simply lack the ceramic skill that experience would bring, while the mechanical construction and combination are such as to invite disaster. Beautiful work is being done in porcelain but it is limited to those who by diligent perseverence have mastered the art. For this work to become popular it is necessary that it be simplified, that every step should be definite and positive toward a finished plate, and that the element of chance and uncertainty be eliminated.

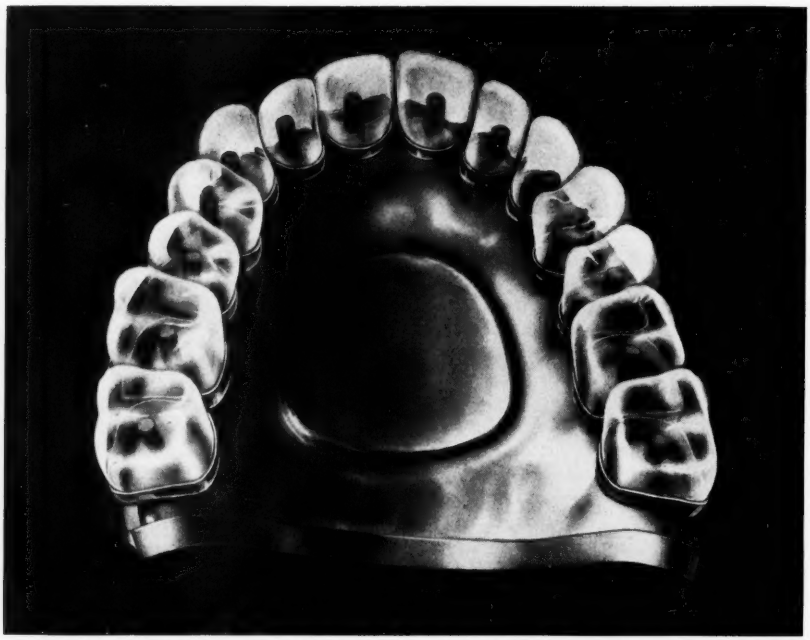
I conceived the idea of continuous gum set in which plate and teeth are separate—unlike those we have been making in which the teeth are fused with the porcelain of the plate in an inseparable mass. In this new set solid full form porcelain crowns are mounted on platinum posts and seated in platinum cups which have been soldered to the plate. (Plate I.) The crowns are not soldered but are removed when the porcelain plate is baked in the furnace. Because the crowns do not pass thru the furnace after being glazed they retain their original strength, color and translucency. If the plate in the regular continuous gum set is a failure then the teeth are lost and all the time spent in grinding them and soldering them to the plate is lost. If the teeth are checked then the plate is lost. This happens because the teeth are soldered to the platinum plate and baked inseparably with the porcelain. With the newer construction the teeth are not destroyed because, as just mentioned, the crowns are not mounted on the plate when it is baked but are cemented on afterwards. Not having been subjected to heat, they retain their liquid lustre, temper and color. This has not been my experience with teeth subjected first to a great concentrated heat in soldering to the platinum plate and to still another heat in fusing with the porcelain body. In a number of experiments with teeth of the same shade, I removed one of the set before subjecting the others to the great heat of the furnace and found, on comparison with the tooth not heated, considerable change of color and loss of lustre. Other experiments made with a special testing machine showed that teeth subjected to the great heat of soldering lost strength. The repeated expansion and contraction of pins and porcelain

is apt to effect the teeth and body, and checked porcelain teeth and weakened plate, not always at first apparent, is sometimes the result.

By this method of having crowns separate and removable from the plate, should the porcelain plate not be perfect when finished, the porcelain can be dissolve any particles of porcelain that may remain. New porcelain can now be added to the plate and the plate rebaked. This can be repeated again and again until a perfect plate results.

In this method of constructing a continuous gum set the porcelain is carried only to the bases or necks of the crowns.

Plate I.



Platinum plate with platinum cups and posts soldered to the plate, and detachable porcelain crowns in position.

removed from the plate by placing it gently in hydrofloric acid: The time consumed in removal depends upon the density of the porcelain and the strength of the hydrofloric acid solution, it takes from a half hour to four or five. If time is an object, another method is to apply a blow pipe and when the porcelain is red hot drop the plate into cold water and the porcelain will crack away from the platinum plate. Then the plate can be immersed in hydrofloric acid to

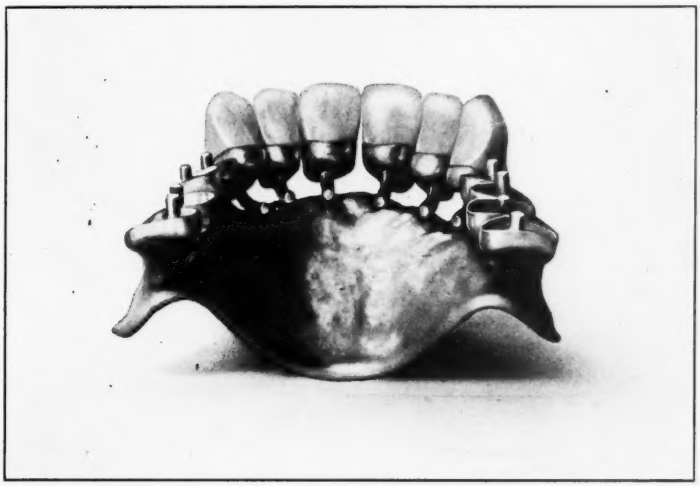
This means a smaller plate, less bulk and more tongue room. The translucency of the crowns is not impaired by a mass of body carried almost to the occlusial edge. Translucency and naturalness are so indissolubly bound that no teeth can present a natural live appearance if the teeth are baked with either porcelain body, vulcanite or gold. The fact that these crowns are not baked leaves them as they were, translucent and artistic. The natural palatal and

lingual surface of full form porcelain crowns afford proper shaped surfaces for the tongue to play upon.

While weight is of secondary consideration to perfect fit and adaptation, in this plate the advantage of weight is also with the newer construction. The smaller and lighter porcelain plate more than offsets the platinum posts and cups which are only slightly heavier than the long platinum pins which are baked in the teeth of regular continuous gum sets.

This matter of weight is especially true in those mouths where the amount of absorption is excessive and we previously have had to resort to tiers of wire scaffolding, (cut) 16 gauge, to which the teeth were soldered, thereby increasing both weight and cost. The teeth soldered to this scaffolding were occasionally drawn out of place during the fusing of the porcelain. I abandoned the scaffolding and devised the simpler method of carrying a straight platinum iridium post thru the longitudinal axis of the teeth and thru the platinum cup to the platinum plate to which it is soldered. Platinum alloyed with iridium should be used only in places where there is ample room for covering it with considerable body for porcelain does not embrace it as smoothly as it does platinum, which is still preeminently the metal to bake in porcelain. The platinum iridium post is bent to meet the platinum plate when necessary. This necessity is ever present in these cases where lost gum tissue makes it imperative to set the crowns any considerable distance off the ridge to restore a proper width of arch. (Plate II). I also use this platinum iridium post extension whenever uneven absorption of bone and gum tissue has resulted in an undulating ridge. For instance, where the alveolar process has almost entirely disappeared between bicuspids and molars but is full and present in the incisor teeth. This extension enables us to maintain graceful curves with approximating crowns and cups by simply making that part of the platinum iridium post under-

Plate II.



Method of mounting Crowns off the ridge where excessive absorption has taken place.

neath the platinum cup long or short. In all cases where the platinum cups do not actually rest up on the platinum base plate and are in soldered contact with each other and the base plate additional reinforcement should be added. One way is by inserting a strip of 28 gauge platinum plate upright between the bottom of the cups and the plate. Both edges should be slit and bent at right angles, then soldered to cups and plate. There is also the corrugated 18 gauge platinum iridium wire reinforcement formed to contact with the base plate and cups. This is a reinforcement that I have not tried. These reinforcements have been found necessary in continuous gum work by men who have had long experience in making and later in repairing it.

When much absorption of gum tissue has taken place, to save weight I employ long crowns, preferably Ash non-platinum tube teeth, which I convert into crowns by sealing the ends with porcelain. The longer these teeth are, the less porcelain plate there is. It is surprising how long a tooth may be and look well if the length of tooth does not unduly protrude beyond the lip line. This is especially true of bicuspids and molars. Nothing looks worse on lower bicuspids and molars than a visible poorly matched gum, whether it be porcelain or vulcanite. Foreign dentists have always used longer teeth than we have and their light excellent vulcanite work has been largely due to the fact that the longer teeth required less visible rubber.

The successive steps in making this new continuous gum set include the impression taken as taught by Dr. Green with this modification: I use his cups and take a thin plaster cast. When set, I cut away the labial and buccal surfaces low enough to allow the compound I add to replace the plaster, and be muscle molded. This is accomplished by heating the cut plaster edge dry and hot over a Bunsen flame and over this edge melting a rim of Detroit modelling compound all around the impression's edge to which it sticks securely. The entire impression is now immersed in hot water and reseated in the mouth. Each side is again reheated and trimmed, then muscle molded. And all compound impression may be used but I have never been able to take as good a compound impression as I have a plaster one but am willing to compromise and adopt a combination of modelling compound and plaster whenever its use seems an improvement on plaster alone. This muscle molded impression gives a cast on the die of which it is possible to swedge a plate that does not impinge on the muscles or frenum; that causes no discomfort and that clings firmly to the roof of the mouth. This is highly important in a continuous gum set, which cannot well be trimmed after the porcelain is fused.

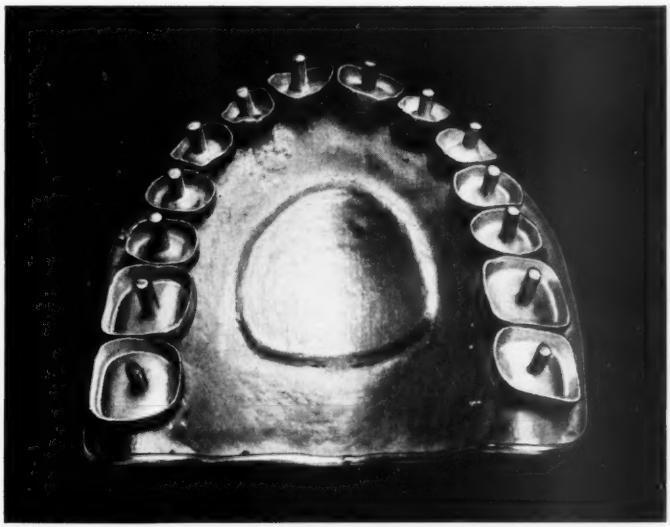
From this impression a cast is made and from this cast a metal die on which is swedged the platinum plate. On this platinum plate are soldered a rim and heel piece of such strength as the case calls for. Wax is now added to the platinum plate for a bite which is taken and the whole mounted in an articulater. The crowns must be ground to articulate. The platinum iridium posts should be ground at the same time. The articulating of crowns will have to be done by ourselves until the manufacturers realize that those they supply do not.

When this work is finished we proceed to the making of the platinum cups, which constitute the great difference between the plate that I have been describing and the plate we have been using. These seamless platinum cups were originally formed by making an impression in moldine of the base of the crown and casting die of Mellott metal. With die I stamped an impression in the block of lead and into this impression drove a piece of platinum. The platinum was occasionally torn and unduly thinned by this method and folds were sometimes formed. This I abandoned and men-

tion here merely to save you from possibly repeating the experiment. Instead I drew a seamless cup. It was made by first taking the measure of the neck of the crown with thin wire, then selecting a mandril to fit the wire measurement and with the aid of a steel draw plate decreasing the size of the platinum disc to a cup that would fit the neck of the crown snugly and correspond in size to the wire measurement. From an impression of the crown a die was made of Mellott metal and the platinum cup swedged over it. This method of drawing an individual cup for each crown took considerable time and might have discouraged some from trying this method, so I persuaded well known platinum supply house to make them for us. I took measurements of numerous crowns and selected average circumferences of the different teeth. From these measurements six sizes were made and among them will be found platinum cups to fit almost any crown set. Platinum, 28 gauge, when drawn to cup form is thinned to 30 gauge in passing thru the press. In cup form this gauge is rather stiff and hard to work and these cups should be restricted to incisors and cuspids; for bicuspids and molars, platinum cups of 32 gauge are amply strong, made of this gauge the metal is more easily worked. Platinum cups made of 30 gauge should be swedged and then driven into a lead plate, the swedger alone does not seem sufficient for a proper adaption of cup to crown After being swedged these platinum cups should be boiled in a 50% solution of nitric acid and water, washed and reboiled in a 50% solution of hydrochloric acid. This thoroly cleans them of any base metal that may be on them.

Each cup is now replaced on the crown for which it is made and carefully burnished to it, then trimmed. Special effort should be made in burnishing to define the post hole. An incision is now made in the platinum over

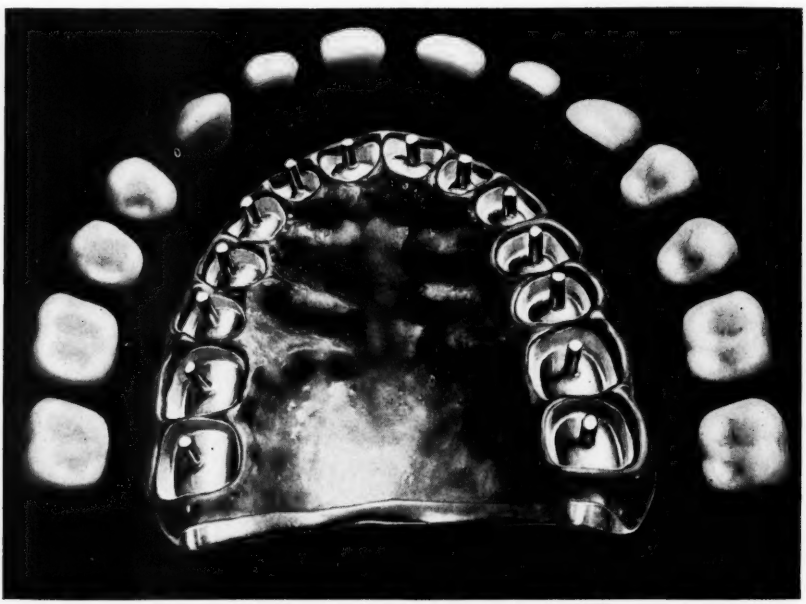
Plate III.



Platinum plate with cups and posts soldered.

the post hole and the post that was originally fitted during the setting up is now forced thru into the crown to a suitable depth. Post and platinum cups are then firmly fastened together with wax. This process is followed with each crown. All crowns are then removed and the platinum cups and posts

Plate IV.



Baked porcelain plate. Note depth of Cups.

invested in a suitable investment—three parts of silica and one of plaster answers the purpose. This investment at the heat used for soldering does not affect the platinum, or disintegrate. When all the platinum cups have been soldered to their posts with high fusing platinum solder, they are replaced on their crowns to which they were adapted and waxed in position on the plate.

When all are in position on the platinum plate and the articulation shows no displacement, the crowns are removed and the platinum plate with

cups and posts in place is invested so that the palatal and lingual surfaces of the platinum cups are free for soldering. Each cup is soldered to the plate with high fusing platinum solder. When the cups are not in contact with the platinum plate the posts alone are soldered to the platinum base plate and reinforced with a platinum upright. When the palatal and lingual sides have been soldered, the investment is cut away from the labial and buccal surfaces and here also when possible, solder is used to attach the cup to the plate. (Plate III). The plate is again thoroly cleaned in the 50% solutions previously given, and washed in fresh water which has been made alkaline.

The crowns are now reset in the platinum cups and coated just above the cups with oil to prevent adhesion of the porcelain body, which, moistened

with dextrin, is now applied. When this has been artistically done and divisions cut out for shrinkage the case is set aside to dry. Then the crowns are carefully removed and the porcelain heated, biscuited and then slowly cooled. By this slow cooling the porcelain retains its strength. It is then examined and the necessary additions of porcelain body made where needed. After this it is again dried, rebaked and slowly cooled. (Plate IV).

The gum enamel is then applied and the case passed into the oven for the final baking and left in the furnace until the furnace is cold. When this is completed the crowns are cemented to the plate preferably with Protosyn or with oxyphosphate or red sulphur. Should any of the porcelain body overhang the cup and prevent the seating of the crown, it can be removed with a fine carborundum stone.

The repair of the fractured plate or a broken tooth is not so serious a matter with this method as it is with the regular continuous gum set. Should the porcelain plate be broken the crowns are removed and the plate repaired in the usual way. The removal of the crowns is easily accomplished by immersing the plate in hydrochloric acid. A protective coating of wax or guttapercha solution should cover all of the porcelain plate except the cement joints to prevent etching the porcelain. If reswedging is necessary the crowns are removed and the porcelain plate dissolved in hydrofloric acid. The platinum plate can then be tapped to fit the new die.

Should a crown be fractured it is a simple matter to grind and cement another in its place. A little hydrochloric acid will free any part of the broken crown that may occupy the cup.

I have a few slides to throw on the screen and a few models on the table that will illustrate this method of making a continuous gum set better than my paper.

DISCUSSION.

John F. Stephan, Cleveland, Ohio: I have no apology to present for not having written my discussion. I am one of those who advocates the elimination of discussions during our meetings. I hope the time will come when we will have nothing but papers so that we will get the meat of the subject considered and nothing of the waste of time that follows frequently in the course of discussion.

We have just witnessed a very beautiful piece of work. The use of the continuous gum set in restorative prothesis is becoming more and more rare and indeed its proper employment has become almost a lost art. Few men attempt now to make the continuous gum denture; this may be because it is work that must be accurately done. We should continue to do this work and to keep our appreciation of its beauty and value. It is valuable as a substitute for the lost teeth in maintaining the contour of the mouth and the health of the individual as well as for its anesthetic value.

The method of construction which Dr. Nies has demonstrated is greatly simplified over that which we have hitherto known. We have, however, used continuous gum sets and some of us have done as the essayist has described, used the slow fusing. It is obvious that if we are going to have teeth of lustre, temper and color we cannot use anything else than the low fusing temperature or we will lose the strength, color and translucency at the time of fusing. Dr. Nies method of construction quite meets this end and I like the tube in the crown. However, this method would have its limitations unless we could adapt other crowns to these cups. Would it not be possible to use the sheet metal and then use platinum of a high percentage as a solder? I see no reason why we could not use platinum of a higher percentage in constructing the

cups and trellis and that would quite simplify the method and a thinner platinum might well be used, for all that is necessary is to hold the porcelain, while it is being baked, in a given form. I noticed that much porcelain was carried up on the finished forms, almost more than it should be, and therefore the cups should not be large. I think much of our difficulty has been due to a lack of understanding of the way in which the materials which we use work. My experience has been that we must bake quickly and the material may fracture a number of times and we must handle our material jealously, allowing it to cool slowly as has been suggested by the writer of the paper. Our porcelain must be brought in thru the investing material and brought to a temperature where it can be soldered and then soldered with the high heat frame. I use the oxygen cylinder and illuminating gas and the Jones blow pipe, and I protect my eyes with blue glasses and I think this is equal to the method we formerly used with the gold work.

To check the cracking, if you will add a little borax, painting over the cracks and then heating, you will not have the lutes. I think this was not spoken of in the essay. The care in baking is of course essential, but one must be very careful of the entire technic in continuous gum work because when the work is finished it is in a fixed position and it should be done so that it will not be necessary to make changes. It therefore has the advantage of making us more careful.

With regard to the high cost of continuous gum work, this is an objection which should not have much weight. The high cost is not a valid objection. The patient wants the best results we are able to produce and he is usually willing to repay us for our efforts. There is no question about this, even patients in moderate circumstances are willing to repay us; they are equally as willing to pay us for our good results as they are to pay a surgeon for producing the cure that they have asked of him.

L. E. Custer, Dayton, Ohio: If seventy-three years ago—almost three-quarters of a century ago continuous gum was introduced to the dental profession, and until today there has been no material change or improvement in the technic, a procedure which has never heretofore been challenged, what shall we say of the nerve, the impudence, or the brazen assurance of one who now steps forth at this day with a "New Continuous Gum Set"? It was due to the inherent intracies of technic and the most exacting carrying out of many details, the failure of anyone of which meant the failure of the whole, that placed the construction of continuous gum dentures in the hands of a few. It is just here that the new continuous gum set has divided the construction into two parts instead of one whole. A flaw in one part does not necessarily mean a reconstruction of the whole set but simply of that part. Moreover the question of color without change is fixed at the very outset and the means of repair of the individual teeth at least is very simple. It seems to me that after a quarter of a centuries' experience in continuous gum work and after studying the scheme laid down by Dr. Nies, that his boldness is well founded and he may well claim "A New Continuous Gum Set."

I need not go into the advantages of selecting and setting the teeth individually before this body for they are too apparent.

On a closer study of the process, however, there appeared to be two objections and only two. The first was one of mechanical weakness as compared to the Allen technic in which the porcelain was fused well between the teeth. I have always found a tendency for a crack to form between the incisors of an upper plate where there were natural teeth below unless the plate was strengthened at

this point with a heavy platino-iridium bar and the porcelain was correspondingly thick. But on a second reading of Dr. Nies' paper I found that he has placed considerable stress upon uniting with solder the entire row of cups so that in this manner he has actually designed an even stronger mechanical gird than by the old method; so at the very outset he offers a stronger plate and the first objection fails.

The second and a real objection is to the amount of time and care necessary for the construction of the platinum cups, but for this I here offer a perfect fitting cup which can be made in a jiffy. It is a most admirable application of a simple method of making a perfect fitting seamless band which I devised and published some twenty years ago.

Take a thirty gauge dead annealed platinum wire, wind it around the neck of the tooth three, four, or five times according to the desired depth of the cup. Remove the coil, place upon a sheet of platinum, and using a piece of Ames solder solidify the platinum coil into a seamless band at the same time unite it to the sheet platinum forming the bottom of the cup. Under a good heat the solder by capillary attraction climbs up between all the coils of wire, making a solid band which if not too much solder is used, will have another and distinct advantage over a swaged cup, for it presents a corrugated surface on the outside for better attachment to the porcelain, and on the inside for the cement. Such a band is a most perfect fit, for each turn of wire makes its own individual adaptation to the tooth as it is wound thereon.

I feel that Dr. Nies has made a lasting name for himself in tendering this unique improvement in Continuous Gum construction.

Frederick H. Nies, Brooklyn, N. Y.: Dr. Stephan has just suggested that a solder having a higher percentage of platinum might be used. There is no reason why such a solder could not be used. I wish to say that I often use high fusing porcelain, but I did not do so in this particular instance because I was using a borrowed furnace and I did not care to risk disintegrating it by carrying it to too high a temperature. The baking of high fusing porcelain always affects a furnace. I did not use the Dental Supply body in any of these sets shown here, but the Ash high fusing porcelain which is excellent, the porcelain fusing at 1900 F. If we take great care in cooling the furnace this porcelain does not crack.

Dr. Custer spoke of the necessity of reinforcements in continuous gum work. Reinforcements are absolutely necessary. Any man who has done any amount of this work knows that if a continuous gum set is not properly and strongly reinforced he is very likely to have the case come back broken. I have in practice even used corrugations to further stiffen the plate, using the rugae for this purpose, supplementing them with additional rugae carrying each past the medical line. A corrugation is also made to extend across the heel of the plate. This is done with a thin bead of half round wax attached to the plaster model. These corrugations appear on the zinc die, and when impressed on the platinum plate in no way interfere with the fit.

It seems to me absolutely necessary to strengthen these pieces with reinforcement if they are to endure. Dr. Custer has given us a new method of making the cups that is well worth trying. All inventions are matters of evolution and every new suggestion or thought is a help which is worth considering and trying.

THE RELATIVE TOXICITY OF COCAINE AND NOVOCAINE.

By George B. Roth, A. B., M. D., From the Division of Pharmacology, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C.

(Read before the National Dental Association at Its Twenty-first Annual Session, New York City, N. Y., October 23-26, 1917.)

SOON after the discovery of cocaine and the announcement that it possessed anesthetic properties, intensive studies were made to determine the relation between its chemical constitution and the production of anesthesia. It was early recognized that cocaine was a dangerous therapeutic agent, and in the investigations that were conducted to ascertain the relation between its chemical nature and its anesthetic qualities, other compounds were discovered which produced anesthesia and were less toxic, but in many cases were too irritant or possessed some other undesirable properties which prohibited their use as local anesthetic agents. Two distinct conceptions were brought out by the early investigators of cocaine to explain the anesthesia which it and its derivatives produce. Cocaine is benzoyl-methyl-ecgonine. It may be resolved into the base ecgonine, methyl alcohol, and benzoic acid.

Stockman, 1886, investigated benzoyl-ecgonine physiologically, and found that it did not paralyze nerve endings in a manner similar to cocaine. He expressed the opinion that the relationship between the action of cocaine and benzoyl-ecgonine was altered by the substitution of the methyl-group.

Filehne, 1887, found that methyl-ecgonine was incapable of producing anesthesia when applied locally, and considered that the benzoyl radical was the essential factor in imparting such anesthetic properties to cocaine.

Poulsson, 1890, regarded esterification with certain aliphatic radicals, such as a methyl, ethyl, or propyl radical, as the most important procedure in producing compounds of the local anesthetic type.

Since the investigations of Stockman, 1886, Filehne, 1887, and Poulsson, 1890, many derivatives of benzoic acid have been discovered which have the properties of a local anesthetic, among them being a compound, the hydrochlorid of which has been given the name of novocaine. It is p-amido-benzoyl-diethyl-amidoethanol hydrochlorid.

Novocaine hydrochlorid occurs as a white substance which is made up of small crystals soluble in one part of water and in 30 parts of alcohol. It melts at 156° C. Its aqueous solution is neutral, from which it can be precipitated by all the common alkaloidal reagents.

At the present time novocaine is perhaps one of the most widely used agents for producing local anesthesia. Its very general use is dependent largely upon the fact that it is usually considered to be a comparatively safe and efficient local anesthetic; also because it has a wider range of application since, besides being readily soluble in water, it can be sterilized by heat.

There is no general agreement among

the various investigators as to the exact toxicity of novocaine. Biberfeld, 1905, concluded that novocaine was one-fifth to one-sixth as toxic as cocaine. Le Brocq, 1909, found novocaine to be about one-half as toxic as cocaine. Piquand and Dreyfus, 1910, concluded that novocaine was one-fourth to one-sixth as toxic as cocaine. Marshall, 1911, found that the relative toxicity of novocaine and cocaine was approximately as 0.3 is to 1.

It is evident from the above statements that the question of the relative toxicity of novocaine and cocaine is unsettled.

The analysis of the literature further discloses the fact that altho the toxicity of novocaine is relatively low, like cocaine, it is sometimes productive of untoward results, death being attributed to it in certain instances.

In consideration of the lack of uniformity in the statements regarding the toxicity of novocaine, it was thought desirable to investigate novocaine further. As in previous investigations, for the purpose of comparison with a well-known substance which is similarly used, comparison was made with cocaine.

The report of the studies made of these substances is dealt with in five parts, namely: (1) toxicity in intact animals; (2) action on heart muscle; (3) action on smooth muscle; (4) effect on the blood pressure and respiration; (5) general considerations.

Toxicity in Intact Animals.

In the following experiments the toxicity of cocaine and novocaine was determined by ascertaining the minimal dose required to produce death within 24 hours when given subcutaneously or intravenously. The minimal dose which was fatal was determined in frogs, mice, rats, guinea pigs and rabbits (1). Their comparative toxicity is shown in the following table:

Table I.—Comparative Toxicity of Cocaine and Novocaine in Frogs, Mice, Rats, Guinea Pigs, and Rabbits.

Animal used	Method of administration	Cocaine, M. L. D. in gms. per kilo of body weight	Novocaine, M. L. D. in gms. per kilo of body weight	Ratio toxicity, cocaine to novocaine
Frogs (R. pipiens)	Subcutaneously	1.000	0.700	1.0 to 1.4
Mice	do	.100	.550	5.5 to 1
Rats	do	.200	2.000	10 to 1
Guinea pigs	do	.060	.600	10 to 1
Rabbits	do	.075	.400	5.3 to 1
Do	Intravenously	.0077	.030	3.9 to 1

The M. L. D. is the amount per kilogram of body weight required to kill within 24 hours.

From the above table it is seen that the relative toxicity of cocaine and novocaine varies and depends upon the animal used in making the determination as well as upon the method of the administration of the drugs. For warm-blooded animals the toxicity of cocaine is from 4 to 10 times greater than novocaine; while for the cold-blooded animal, the frog, the toxicity of novocaine is slightly greater than cocaine.

If cocaine or novocaine is given to anesthetized rabbits, intravenously, in dilute solutions at about five-minute intervals they will tolerate larger amounts of the drugs than when they are given

(1) The details of these experiments and those reported later in this paper appear in Bull. 109, Hygienic Laboratory, 1917, Washington, D. C.

in a single dose, as was done in the unanesthetized animals. For example, a rabbit weighing 1.8 kilos, which was anesthetized with paraldehyde received during the course of one and one-half hours 49 mgs. of cocaine hydrochlorid intravenously, the equivalent of 27 mgs. per kilo of body weight. To another rabbit weighing 1.64 kilos, which was similarly anesthetized, with the exception that a small amount of ether was occasionally required, 305 mgs. of novocaine were given intravenously before death resulted. This animal, therefore, received an amount of novocaine which was equivalent to 186 mgs. per kilo of body weight.

When these experiments are considered, together with the results obtained in unanesthetized rabbits, we must conclude that, when given slowly and in high dilutions by vein, an amount may be tolerated which is several times greater than that which is fatal when given as a single dose in concentrated solution. The concentration of the drug in the blood at any given time is a very important factor in determining the toxicity of either cocaine or novocaine. The rate of the injection, together with the concentration employed, must therefore be taken into account.

The ratio of the toxicity of cocaine and novocaine for mice, when fed on cakes containing these substances, is much wider than when given in any other way, cocaine, being about fifty times as toxic as novocaine.

The mice which died from eating the cakes containing cocaine showed marked liver changes, the organ being pale yellow in color whereas the liver in those mice which died after eating the cakes containing novocaine presented a dark brown congested appearance.

Sections of the liver were not made in any case so that the minute changes were not ascertained. Ehrlich, 1890, studied the minute liver changes produced by feeding cocaine to white mice and found that it caused marked destruction of the liver cells and that they later became greatly infiltrated with fat.

Hatcher and Eggleston, 1916, have recently advanced evidence that novocaine is destroyed by the liver. The findings of Hatcher and Eggleston therefore may afford an explanation for the lessened toxicity of novocaine when given by mouth than when administered subcutaneously or intravenously. In the former case the liver receives it first and partly detoxifies it while in the latter case it enters the systemic circulation directly and is dissipated to all the organs.

Inasmuch as the above toxicity studies relate only to the effects of these substances after their entrance into the circulation, their general toxicity should be considered in relation to their local anesthetic action.

In this regard Cushny, 1915, states that novocaine is from one-third to one-half as toxic as cocaine when given to animals while the anesthetic effect of novocaine is only one-tenth that of cocaine. Gros, 1910, found that the effect of novocaine upon the sciatic nerve of the frog was only one-half that of cocaine. Closson, 1914, compared the anesthetic properties of novocaine and cocaine on the endings of the sciatic nerve of the frog and found that novocaine was less than one-half as effective as cocaine.

If, therefore, the same degree of anesthesia is to be secured by the two substances the concentration of novocaine must be increased over that of cocaine and so their absolute toxicity, or their toxicity in relation to their anesthetic action, approach each other closely.

Action on Heart Muscle.

The effect of cocaine and novocaine on heart muscle was studied on the isolated heart of the frog, using both the *Rana esculenta* and the *Rana pipiens.*

Perfusion was done with the drugs dissolved in Clarke's solution (2).

The effects of cocaine and novocaine on heart muscle are very similar. On the isolated heart of both the *Rana esculenta* and *Rana pipiens* dilute solutions of either substance caused a slight decrease in the amplitude of the contraction and relaxation together with slight or no changes in the rate. Concentrated solutions caused a quite marked decrease in the amplitude of the contraction and relaxation together with a decrease in rate. Cocaine produced a more pronounced depression than novocaine. The relative toxicity for the heart as shown by perfusion of the frog's heart was 1 to 4, i. e., it required 4 times more novocaine than cocaine to produce a similar depression.

Action on Smooth Muscle.

The effects of cocaine and novocaine on smooth muscles were compared by observing the response of isolated segments of the ureter of the dog, intestine of the rabbit, urinary bladder and stomach of the cat, and uterus of the rabbit when placed in varying dilutions of the drugs in oxygenated Locke's solution (3).

The effect of novocaine on smooth muscle differs slightly from that produced by cocaine. On the isolated ureter of the dog, the isolated urinary bladder and stomach of the cat, and the isolated uterus of the rabbit, the effect of novocaine differs from that of cocaine only in being stimulating to a less degree when similar dilutions are used. On the isolated intestine of the rabbit, cocaine stimulates in dilute solutions, and in concentrated solutions depresses intestinal motility, whereas novocaine depresses it in any effect concentration.

(2) Clarke's solution was made up as follows: NaCl 0.7 per cent; $CaCl_2$ 0.012 per cent; KCl 0.014 per cent; $NaHCO_3$ 0.02 per cent.

(3) The Locke's solution used contained NaCl 0.9 per cent; KCl 0.042 per cent; $CaCl_2$ 0.024 per cent; $NaHCO_3$ 0.03 per cent; and dextrose 0.1 per cent.

Effects of Cocaine and Novocaine on Blood Pressure and Respiration.

The blood pressure and respiratory changes resulting from cocaine and novocaine were studied in dogs, cats, and rabbits.

Effects on Blood Pressure When Given Intravenously.

The effects of cocaine and novocaine on the blood pressure of dogs, cats, and rabbits are essentially alike. When either drug is given intravenously in small doses to anesthetized animals a rise in pressure usually occurs while after large doses a fall in pressure is produced. The rise which occurs after the use of small doses of cocaine is generally higher than the rise produced by novocaine, and it is produced by smaller doses.

The dose of novocaine, required to produce a rise in pressure in the rabbit, varies from 5 to 15 mg., while in the dog 10 to 40 mg. are required. The rise may be seen in cats after doses varying from 5 to 20 mg. In dogs and rabbits the rise is not always seen; in some rabbits 5 mg. may produce a fall. By the use of doses larger than 20 mg., a fall usually occurs in either dogs, cats, or rabbits, altho in some dogs 40 mg. will produce a rise. A dose which produces a rise in pressure on first injection may, if given later in the experiment, produce a fall in pressure.

Effects on Respiration When Given Intravenously.

Novocaine resembles cocaine in its effect upon the respiration of dogs and rabbits when given intravenously. Cocaine quite markedly stimulates the respiration when small doses are used and depresses it when larger doses are employed; whereas novocaine as a rule has a slight stimulating effect in small doses and in larger doses depresses respiration. In the cat a stimulating effect on the respiration was never noticed.

Effects of Novocaine on Blood Pressure and Respiration of Rabbit When Given Subcutaneously.

In order to ascertain the effect of novocaine on the blood pressure and respiration when a large dose is injected subcutaneously, a 2-kilo rabbit, anesthetized with paraldehyde, was given a subcutaneous injection of 0.2 gm. of novocaine dissolved in water. A distinct depression of respiration and blood pressure together with a decrease in heart rate was found to occur after one hour when given in the above manner.

Comparative Effects of Cocaine and Novocaine on Blood Pressure and Respiration of Dogs When Given Intraspinally.

By means of dogs it was shown that a fall in pressure results from the intraspinal administration of either cocaine or novocaine in large doses, and that the extent of fall is practically the same for both substances. The respiratory effects are unlike, however, in that cocaine may stimulate respiration previous to depressing it; whereas with novocaine there is little or no primary stimulation preceding the depression. These experiments would indicate that there is little, if any, difference in the toxicity of novocaine and cocaine when given intraspinally to dogs.

Cause of Death from Cocaine and Novocaine Poisoning.

The cause of death from novocaine poisoning was investigated on dogs and rabbits. In dogs which had received novocaine either intravenously or intraspinally the respiration stopped from about one-half to one minute before the heart. In rabbits death would always occur from respiratory failure if the novocaine was injected slowly into the marginal ear vein. In these instances the animal would live for some minutes after the injection, as, for instance, when the drug was injected intravenously and the injection period was 2 to 3 minutes long. If the novocaine was injected rapidly, the animal receiving the entire amount in from one-fourth to one half minute, death would be cardiac, the heart stopping under these conditions 10 to 15 seconds before the respiration had ceased. Death from novocaine is usually respiratory, therefore, but under certain conditions it may be cardiac, the interval between the stoppage of the heart and respiration being very short. In both rabbits and dogs death from cocaine was always respiratory, regardless of the method of its injection.

General Considerations.

Toxicity of Cocaine and Novocaine in Man.

It is impossible to determine accurately the relative susceptibility of man to cocaine and novocaine, on account of the fact that the cases of novocaine poisoning are just beginning to find their way into the literature. However, from physiological tests on man and from the available reports of the cases of poisoning an approximate idea of the relative toxicity in man may be computed.

In reviewing the literature relating to cocaine poisoning, it is found that the fatal dose varies from 0.020-0.030 gm. to more than 1.25 gm., while 0.008 gm. may produce dangerous toxic symptoms. Cushny, 1915, states that, for subcutaneous injection, the dose of cocaine should never extend 0.020 gm.

The maximum dose of novocaine tolerated by man without producing general symptoms, like other local anesthetics, depends largely upon the method of its administration. The dosage used by clinicians is remarkedly wide. Under certain conditions 0.020 gm. has caused death; where as 2 gms. have been given in other cases without producing symptoms. It would appear, however, that

when given intraspinally or for dental operations it may be especially toxic. By the intraspinal method of administration 0.100 gram has produced death.

Consideration of Laboratory Findings and Their Relation to Clinical Reports.

The results of the laboratory experiments with cocaine and novocaine, when compared with the results obtained in the clinical use of these substances, show that man is relatively more susceptible to cocaine and novocaine than are laboratory animals. From animal experiments it is seen that the toxicity of these substances depends partly upon the manner and method of administration. The statement also seems to hold true for man. The untoward results that have been reported in the literature from the use of novocaine in operations about the head and face might well be accounted for by the fact that absorption may be very rapid, as for example in dental operations when the injection is made in a region well supplied with blood vessels, so that administration directly into the circulation is not unlikely to occur, and when injected in this way the toxicity is greater than when given subcutaneously. Individual susceptibility is marked in both animals and man. This may account for some of the fatalities reported in the literature.

Factors Which Should Be Considered in Use of Cocaine or Novocaine.

In addition to idiosyncrasy, age seems to be a factor in man in the production of a fatal result with novocaine. In three cases reported by Scandola, 1915, the ages of the men were 69, 75 and 80 years, respectively. In cases having low blood pressure, or cardiac disease, novocaine should be used with caution, inasmuch as in the laboratory experiments it has been shown to have a depressing effect upon the heart muscle when large doses are given.

The administration of hyoscine, previous to the use of a local anesthetic agent, is sometimes advised. If it is given before either cocaine or novocaine, it may act as a synergistic agent in depressing the respiration. In order to prevent the absorption of novocaine from the subcutaneous tissues, epinephrine is employed. Epinephrine is a relatively unstable agent, especially in alkaline solutions. It is not unlikely, therefore, that unless the epinephrine which is used with novocaine is active, general symptoms may arise from the administration of novocaine as a local anesthetic agent.

Consideration of Some of the Reputed Advantages of Novocaine Over Cocaine.

It was previously stated that the widespread use of novocaine has been due largely to the fact that novocaine is considered to be comparatively non-toxic and that it can be sterilized by heat without losing its effectiveness. In addition novocaine is considered to be non-irritant to the tissues, or less irritant than cocaine when used locally.

In searching the literature no reference was found which contradicted the numerous statements which are made indicating that novocaine can be safely sterilized by ordinary means. However, the references relating to the sterilization of cocaine solutions by heat are contradictory. Aqueous solutions of cocaine are usually stated to be unstable and that when boiled undergo decomposition readily. Regarding this point Braun, 1914, states that a single boiling of a solution of cocaine is not followed by a material loss of cocaine. He further states that Tuffier advises the fractional sterilization of cocaine solutions at a temperature of 60 to 70 degrees C. The exhaustive work of Lesure, 1909, demonstrated that solutions of cocaine hydrochloride may be heated in an autoclave at 120° C. for thirty minutes without much loss in activity and that the amount of decomposition varies directly

with the alkalinity of the glass. Decomposition was almost neglible when solutions of cocaine were heated in glass containers of low alkalinity while in the ordinary glass containers the loss may not exceed two per cent. When sterilized on the water bath at 100° C. the decomposition was exceedingly small. Lesure concludes that solutions of cocaine hydrochloride may be sterilized at 110-120° C. in closed glass containers provided the alkalinity does not exceed three cubic centimeters of a one-hundredth normal solution of sodium hydroxide. More recently, Holbrook, 1912, found that cocaine hydrochloride was not decomposed to an appreciable extent by boiling for a brief period.

As to the relative amounts of local irritation produced by cocaine and novocaine it may be said that both substances are relatively non-irritant when properly used. Braun, 1914, says that the reports of local damage to the tissues from subcutaneous or submucous injections of cocaine solutions exist only in the older literature and that up to the present time injury to the tissues has never been observed following the injection of dilute cocaine solutions. Dilute solutions of cocaine, up to one per cent, will cause swelling of the tissues and pain. These effects are due to the fact that the solutions are hypotonic. To prevent this sodium chloride an indifferent salt must be added to make them isotonic with the blood.

Many are averse to using cocaine on account of the danger of the patient later becoming a habitue. As yet no report of the occurrence of a novocaine habitue has been made so that it would seem that novocaine is without habit-forming properties; if this be true novocaine possesses at a decided advantage over cocaine in this respect.

Summary and Conclusions.

1. Novocaine is several times less toxic for laboratory animals than cocaine, the relative toxicity being dependent upon the method of administration as well as upon the animal used in making the determination.

2. Novocaine possesses many of the properties of cocaine as shown by experiments on the isolated heart, on smooth muscle, and by its effects on the circulation and respiration of anesthetized animals.

3. The depressing effect of novocaine on the blood pressure and respiration of animals, makes it necessary to use caution in its administration in clinical cases, in which the blood pressure is low or in which the heart is depressed.

4. Great care should be exercised in the injection of novocaine subcutaneously, in order to avoid its entrance into the circulation thereby increasing its toxicity.

5. Individual susceptibility should always be considered in the administration of either cocaine or novocaine.

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Discussion.

Dr. J. E. Nyman, Chicago, Ill.

The findings of Roth are in accord with those of other investigators and the belief of practitioners in general. It is to be noted that the preparations used in his experiments did not contain suprarenin, epinephrin, or any other adrenalin content. The adrenalin content beneficently modifies the action of the anesthetic preparation, localizing and magnifying the anesthesia and minimizing the systemic action of the anesthetic agent. From clinical experiment and observation, I believe that the immediate reaction sometimes observed is due to the amount of the adrenalin content, the rapidity of, and the pressure exerted in injection. In low blood pressure cases the adrenalin content in the 2 per cent. solution of the E novocaine tablets is advisable. In comparatively high blood pressure cases this should be reduced to the content obtained in a 2 per cent. solution of the T novocaine tablets. As to the relative anesthetic power of the two agents, it may be observed that as the cold blooded mammal exhibited a markedly different reaction as to the toxicity of the two agents, it may be that the anesthetic power of the two agents as reported exhibited in the experiments of the sciatic nerve of the frog would not be identical with that exhibited by a similar test in a warm blooded mammel. Furthermore, it is not stated as to whether the anesthesia was produced by surface application or by injection. I have observed the anesthesia effect by surface application in the eye and the nose is greater with cocaine than novocaine solutions of equal strength, and so too are the systemic reactions resulting; while in anesthesia by injection I observe no difference between the two agents in similar solutions. It is evident that novocaine solutions are more stable than those of cocaine. I prefer novocaine to cocaine as an anesthetic agent for conductive or infiltration anesthesia, because it is less toxic, has equal anesthetic power when injected, and there is no danger of the development of drug addition. Anesthesias in the maxilla may be established by a 1 per cent. of 1.5 per cent solution of novocaine, while in the mandible a 2 per cent. solution is used, owing to the difference in porosity of the cortica of the bone.

Dr. Roth: I have very little to say in answer to Dr. Nyman, but there is one thing that comes to my mind in relation to the relative stability of the solutions. Dr. Nyman referred to the fact that only solutions that are freshly made should be injected. Old solutions of novocaine have been found to cause necrosis and other deleterious local effects. Fresh solutions should by all means be used in every case. Cocaine solutions are said to be stable if alcohol is used as a solvent (15 per cent); that would be a way of making cocaine solutions so they could be kept on hand.

DENTAL TRAINING FOR THE NAVY HOSPITAL CORPS.

How the Bluejackets of the U. S. Naval Training Schools in Minneapolis Are Learning the Significance of Oral Hygiene.

By Willard Connely, U. S. N. R. F.

WHEN college training for a detachment of one hundred navy hospital apprentices was instituted at the University of Minnesota last fall, it was felt that work in dentistry, tho pertinent and highly desirable, could not well be fitted into the schedule in the time allotted. The step was an experiment. Never before had any but regularly prepared students been admitted to a medical college. With therapeutics, physiology, anatomy, pharmacology, first aid, nursing and dietetics to master, the sailors, it was thought, would be thoroly busy. The original contingent departed for active sea or coastal duty in February, without dental training.

Then the professors convened to discuss the program for the second hundred men. It was agreed that a hospital corpsman would be even more handy if he could treat an aching tooth of his mate, if he could make a temporary filling or extract, if he could wire a fractured jaw, alleviating gingivitis and pyorrhea, or if he were taught to look to the mouth for the source of rheumatism. By cutting a medical lecture or laboratory period here and there, and figuring on a four months' term of training instead of three, the teachers arranged to shift an important share of the instruction to the college of dentistry.

These bluejacket students, detailed to the Minneapolis station by the Bureau of Medicine and Surgery, came from Pacific coast naval bases, where they had already been indoctrinated somewhat in preliminary hospital work. So the training at the university medical college has been an advanced course, fitting the corpsmen for immediate duty in the sick bay of a dreadnought. On the other hand, the study of dental methods ashore was completely new to the sailors, since heretofore dental officers in the Navy have taught their own assistants at sea, where a great variety of regular clinical work is naturally unavailable and where, moreover, hospital apprentices have had no opportunity to learn dental rudiments. Consequently, it is not surprising that the corpsmen in Minneapolis have exhibited a lively, unflagging eagerness to absorb every last point about dentistry that they can get in their condensed wartime instruction. The work influences and impresses them personally. On seeing the momentousness of keeping their own teeth intact they will, it may be anticipated, preach severely the gospel of oral hygiene amongst their comrades in other lines of the service aboard ship.

If people carried around toothbrushes in their pockets as religiously as they carry handkerchiefs, few would require a dozen teeth yanked out because of the ravages of pyorrhea. "It would be a reminder," said one of the enlisted men seriously, "if toothbrushes, with protecting caps screwed over them, were fastened on the ends of pencils."

For the first month the corpsmen are given a series of lectures, illustrated by lantern slides, charts, and large plaster teeth detachable from their mouths.

These talks of course cover the introductory fundamentals, including histology of the teeth, dental anatomy, dental caries, and oral hygiene in general. At the beginning of the second month the bluejackets are sent into the laboratories for observation, demonstrations, and actual work upon civilian patients and upon one another. The lectures continue, but only once a week, when the entire class meets. The remainder of the work is sectional, in groups of five, ten, or twenty, according to the nature of the subject taught. Fifty new sets of instruments were purchased by the college for the sole use of the hospital apprentices when doing their two-divisional work interchangeably. First to lecture, then to demonstrate, finally to "let the man do it himself" is the swift scheme for the sailors.

Graphically to comprehend occlusion and the conformation of the upper jaw and mandible, no better work could be designated than a course in elementary prosthesis, with a series of exercises in tooth dissection. In the prosthetics laboratory (where groups of ten bluejackets work for an hour and a half at each lesson) the men begin with the modeling compound and take a full upper impression, from which they mould a plaster cast. After making a similar impression and cast for the lower jaw, the men mount the two casts in occlusion on a wire articulator, and study them. As with a mirror, there is a definite vanity about viewing a part of oneself in plaster too. A life mask of the teeth is undoubtedly fascinating, and whatever is fascinating may be pondered over without effort. The sailors compare jaws with boisterous rivalry, tho those with crooked teeth do not hasten to exhibit.

Next the superior maxilla is modelled, using artists' modelling clay. For each workbench a tray of a thousand teeth extracted from bygone sufferers is provided, and from these the corpsmen select the sixteen uppers and imbed their roots along the alveolar ridge in their normal position. The men are required to pay careful attention to the form of the dental arch and the tooth inclination. Then, to test what the apprentices have remembered from the lectures, the instructor asks them to indicate the median line, the tuberosities, the infraorbital foramen, posterior dental canals, anterior palatine fossa, posterior palatine foramen, retro-molar fossa, the mylohyoid groove.

The seventh exercise is to model similarly the mandible, and to supply the proper teeth. Here the students are told to locate the condyles, the sigmoid notch, coronoid process, ramus, body, mental foramen, mandibular foramen, external oblique line, internal oblique line.

The resulting jaws in juxtaposition constitute not merely a souvenir; they remain a piece of "architecture" for intimate and valuable reference in the future—an infinitely better guide than a picture in a textbook.

Supplementary work in dental anatomy prescribes first the cutting of a longitudinal section of an anterior tooth. Having had tooth structure explained by chart and sketch in the lectures, the men are instructed to cut to the center of the pulp cavity, and to make note of its size, the relative thickness of the enamel, dentin, and cementum. The second lesson is to cut a cross section of an upper molar by grinding down the occlusal until the pulp cavity is opened. All of the occlusal wall is removed so that the openings into the various root canals in the floor of the pulp cavity can be located. The final exercise is the same process for a lower molar.

In operative observation there are nearly two months of lectures and demonstrations to small groups of men, before the laboratory work starts. The composition of dentin and enamel is discussed, with emphasis on the relative amounts of organic and inorganic material in each. The comparative progress made by caries thru enamel and dentin is also stressed. Then the predisposing

When the men work upon one another in oral hygiene it can well be imagined that they overlook neither calculus nor cavity. They search, probe, scrape, and when the patient's revenge comes he too is of course merciless.

cause of decay, incomplete enamel, and the direct cause, fermentation, precede the attention directed to effects of decay on dentin and pulp. When these points are illustrated vividly in actual patients, the instruction "gets home" to the men. Then follow pathology of the pulp and infections of the periapical tissue. Concurrent with this subject, an adequate amount of time is devoted to infections or inflammations not due to decay.

Technic of procedure follows. In removing decay the apprentices are shown how to gain access to the cavity, how to remove decay by hand instruments, and the retention form for filling. Under the application of treatments, come sealing the cavity, varnishing with cotton, temporary stopping, and zinc oxide cements. Taking up prognosis, the navy men learn that, if the pulp is infected, it may be several hours after treatment before pain ceases, and that in the meantime an irritable bluejacket patient may demand extraction.

For the operative practice in making and applying fillings, each sailor is assigned a chair; his patient may be a civilian or one of his mates. Instructed in the use of the engine, he prepares cavities and inserts fillings of cement or amalgam. A faculty assistant for every five men attends.

To oral hygiene demonstration and practice is devoted more time than to any other single study, since it is here that the necessity of the prime abortive methods can best be shown. Typical skulls are introduced to illustrate the disastrous results of abnormal occlusion following the loss of the first molar. One significant talk takes up the pathology of acute and chronic apical abscesses, the dangers of impacted teeth, and the relation between oral infection and systemic disease, concluding with a discourse on the rheumatic chain of maladies.

In sections of ten men the bluejackets have a demonstration by charts, casts, and photographs to show the causes and treatment of gingivitis and pyorrhea, illustrating the bacterial, malocclusive, and systemic points. Each man is familiarized with the instruments used to remove calculus and stains, and with other factors in treating gum disease and in maintaining the health of teeth and gums. Hygienic diet is defined, together with the conditions which result from negligence in this direction. The students are cautioned not to confuse pyorrhea with those diseases which may be mistaken for it. Mechanical agencies causing tooth movement are enumerated, and the treatment for such movement is outlined. This part of the training naturally culminates in a lecture on the technic of cleaning the teeth by the operator and by the patient himself.

Then the hospital apprentices are ushered into the examining room where every man has his mouth scrutinized by the instructor, who points out pathological conditions and suggests the methods for remedying them. One corpsman, twenty years old, displayed thirty-two perfect teeth, not one ever having been invaded by caries. A great many other cases required scant attention or none at all, but in others, as may be expected, there were numerous cavities or surplus wisdom teeth. The average assuredly attested the high physical requirements demanded in the Navy. At any rate, these apprentices will all go to sea with their teeth "fixed" for a long time to come, with their teeth "shining" examples to all their mates.

After the faculty dentist has explored the mouth of each bluejacket, half the men sit in chairs while the other half bend over them and clean, polish, remove calculus, or treat incipient gum inflammations. The final step in this oral hygiene practice arrives when the navy men are put to work on civilian patients who come daily in droves to the university clinics.

Practice in extraction is considered especially useful, for emergencies will arise at sea which call for just such work by the hospital apprentice. The

In the prosthetics laboratory every hospital apprentice takes an eager interest in fashioning the plaster cast of his upper jaw and mandible. The introduction of dental training for navy corpsmen merits continuation, for the results will be indubitably far-reaching.

men are taught to use both forceps and elevator; and tho the bulk of the instruction is given in the one style of forceps most generally used (in case a ship does not carry a full set of instruments), all corpsmen learn to distinguish the varicus kinds, and in what sort of work to employ each. Indications for extraction are given as a broken arch, a broken tooth, broken down roots, acute abscesses, and a tooth decayed half or more; contra-indications, small decay and firmness.

In connection with the training in extraction, dental anesthesia is studied. At the medical school the apprentices are drilled thoroly in both general and local anesthetics; this detail is a part of their course in pharmacology and therapeutics. They anesthetize one another locally with cocaine; they etherize animals. To compute and to administer hypodermics is taught with all precision at the university hospital, where later the bluejackets anesthetize patients in the operating rooms. So when the men arrive at their more advanced stage of instruction in dentistry (extracting and oral surgery), they are well grounded in precautions and technic which are helpful in the administration of novocaine and nitrous oxide.

Anatomical and pathological considerations incident to selective nerve blocking are taken up; for example, in the case of extracting the third molar of the mandible the necessity of anesthetizing the entire inferior dental nerve is explained, and the accessibility of this nerve to the novocaine needle (first on a skull, then on a patient) is carefully indicated. In pathological cases, as in the lancing of boils, the use of nitrous oxide is shown.

As hemorrhage and pain are immediate consequences of extraction, it is considered equally indispensable that the corpsmen know something of their control. For the former, they are instructed in the use of adrenalin chloride packs, tannic acid, and ferropyrine. To subdue pain, the men learn to spray novocaine and iodoform in the socket, and to apply eugenol. Removal of blood clot and stimulation of hemorrhage are also demonstrated in specific cases. After extraction of abscessed teeth the indications and contra-indications for curettement are defined.

The oral surgery clinics give the hospital apprentices the opportunity to observe such operations as the setting of fractured jaws by wiring, drainage of the antrum in sinusitis, and the amputation of abscessed root apices for the purpose of filling the teeth at the bottom. At these operations the corpsmen ably assist the surgeons as well as "look on." Hundreds of patients daily applying for treatment at the dental college afford an extremely valuable variety of clinical material.

Knowing well that only a smattering of the art can be taught in the apportioned time, the professors have no idea in this short course of allowing the sailor to think he is a dental student. The motive of the instruction is essentially to qualify the hospital apprentices to give first aid. Many of these bluejackets may be detailed to ships carrying no dental officer, or to points where such an officer might not be reached for hours or even days. It will be within the powers of the men who have had the training described to render emergency relief, so that when the surgeon does see the patient, the surgeon's work will be a propitious continuation of treatment and not a delayed beginning.

Instruction for enlisted men in a dozen branches is carried on at the U. S. Naval Training Schools in Minneapolis, instruction ranging all the way from the cook's galley to the assembling laboratories for student officers in aviation. No part of this work contributes a more timely national service than the tremendously effective teaching of hospital corpsmen at the medical and dental colleges of the University of Minnesota.

THE EFFECT OF EMETINE ON THE WHITE BLOOD CORPUSCLES.

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IT IS well known that from the viewpoint of the biologist the amoeba and the leucocyte, especially the polymorphonuclear cell and the endothelial leucocyte, are very closely related—particularly from the functional standpoint. On the basis of this fact it would seem possible to influence the behavior of these cells similarly. The application of emetine hydrochloride in conditions where amoeba were directly or indirectly involved, as well as the known amebicidal effect of emetine in prescribed experimental procedure suggested to us, that beyond the apparent toxic results of emetine in larger doses there must be either a transitory or temporary effect on the leucocytes in the bloodstream or at their points of origin, even when using therapeutic doses. It is true that the specific toxicity of emetine extends in a smaller degree to ordinary forms of amoeba, but there ought to be some leucotoxic action for emetine.

If emetine is leucotoxic, it would not be unique, for it is established fact that there are drugs that can be lymphotoxic and leucotoxic (Binz, Heinecke, Chassavant, Wilkinson, Maurel, Heinz, Roth, Bunting, Sherrington, Weiskotten Schwartz and Steensland, Selling, and others). We were unable to find any studies of the leucotoxic action of emetine except those of Maurel and Nielsen. Heinz, in his Handbuch der experimentelle Pathologie and Pharmakologie reviews the literature up to about 1900 on drug action related to white blood cells. Since 1903, such data if published would be reviewed in the Folia Haematologica. In addition we checked the files of the Societe de Biologie, and Journal of Pharmacology and Experimental Therapeutics, as well as the principal papers on the pharmacology of emetine.

Maurel has studied the behavior of leucocytes since 1881. His method with emetine consisted in adding it in varying amounts—0.125 to 2.0 gms. to 100 grams of blood, human or rabbits. He states that the white-blood cells lose their activity and vitality while the red-blood cells apparently remain unaltered. Nielsen found no change in the blood cell-count of three rabbits after injecting 6 mgms. or repeatedly injecting 4.5 mgms. daily in rabbits weighing about 1.242 kilograms. We believe the counts were made too late after injecting.

The following data may have a bearing on this work. Meyer and Williams showed that emetine decreases the CO_2 content in the blood. Pellini and Wallace demonstrated an increase in nitrogenous metabolism. Magendie and Pelletier's work in 1817 that there is an

hyperaemia and inflammation of the gastrointestinal tract following emetine administration has been confirmed repeatedly (Pecholier, Duckworth, Podwyssotzki, and others). It is known that such irritation of the gastrointestinal tract may be associated with a leucocytosis. Abl has been shown that uric acid excretion can be influenced by drugs. With ipecac, the mother substance of emetine, he obtained an increase of 42 and 48 per cent. in one case, and a slight decrease in a second case. This is significant when we learn that an increased uric acid secretion accompanies a leucocytosis. Other questions that arise are the following,—Does emetine mobilize the leucocytes chemotactically? Does the fall in blood-pressure influence the white-cell count? Does emetine influence the temperature which in turn is said to be accompanied by white-cell changes? Does emetine show a diphasic phenomenon on the leucocytes as benzol and other drugs? Does emetine produce structural changes in the leucocyte as it does in the amoeba? Is the blood picture the same thruout the circulation as it is in the peripheral circulation? Is emetine a specific poison to the leucogenetic centers?

We counted the white blood cells after injecting emetine hydrochloride, in rabbits and man. There is no such strikingly average white-cell correct for rabbits as for man, as seen by the following figures:

Maurel, extremes, 5270-10230.
Galland and Goodall, 10500.
Burnett, 8500.
Wells, extremes, 3300-14650; average, 9000.
Ewing, 8500.

(White blood corpuscles in rabbits—Soewitt, Hirschfeld, Hesse, Bezancon and Sabbe, Tallquist-Willebrand, Furno, Brincherhoff and Tyzzer, etc.) We obtained the same results. However, for an individual rabbit there is a fairly accurate average. Further, in the rabbit there seems to be no distinct period of "alimentary lecocytosis," so that the changes produced by emetine should occur shortly after injection, or else affect the body by producing phenomena similar to tolerance.

The rabbits were weighed daily, and the temperature was determined before experimenting, averaging 102-103 degrees. The blood was usually taken from the ear, and the injections were either intravenous or intramuscular. In man, the injections were intramuscular, in the buttocks.

The following are examples of the results obtained:

I—A fresh solution of emetine HC1 was used. 2 mgms. per kilogram intravenously.

Rabbit No. 91—	W. B. C.
Before injection	6250
One hour after injection	7700
Two hours after injection	9900
Second day	6350
Injected 2 mgms. per kilo	
23 min. after	11100
3 hours, 45 min. after	9300
Third day	8600

Rabbit No. 98—	W. B. C.
First day	12550
Second day	11950
Injected.	
15 min. after	13700
1 hr., 8 min. after	23100
4 hrs., 8 min. after	14200

Rabbit No. 100—	
First day	10250
Second day	10200
Injected.	
21 min. after	8350
1 hr., 21 min. after	9485

II—Series with old solution of emetine HC1. Intravenous injections.

Rabbit No. 99—	
Normal	8450
Injected.	
1 hr., 5 min. after	5850
1 hr., 50 min. after	8050

Rabbit No. 98 A—

Normal 5150
Injected.
25 min. after 7200
55 min. after 6500

III Series—rabbits previously used for emetine injections.

Rabbit No. 97—

First day—Leucopenia.
Third day—Leucocytosis.
Eighth day—Leucopenia.
IV Series—intramuscular injections.

Rabbit No. 88—Leucocytosis.

Rabbit No. 89—Leucopenia.

V Series on Man—Intramuscular injections of 30 mgms.—no food for 4 to 7 hours. Blood taken from lobe of the ear.

Mr. B.—Apparently healthy.

First day—Leucopenia in 30 min.
Second day—Leucopenia.
Third day—No change.
Fourth day—No change.
Fifth day—No count and no injection.
Sixth day—Leucopenia marked.
Seventh day—Leucopenia less marked.

Mr. M.—Apparently healthy.

First day—Slight drop.
Second day—Same.
Third day—Same.
Fourth day—No change.
Fifth day—No count and no injection.
Sixth day—Slight drop.
Seventh day—No count and no injection.
Eighth day—Slight drop.

We are not attempting to draw any conclusions as yet, but the tendency seems to be a leucopenia in the peripheral circulation following emetine hydrochloride injection. How this is produced is another problem, but we believe that emetine is a leucotoxin.

A SIMPLIFIED METHOD OF REMOVABLE BRIDGE WORK USING THE YIRIKIAN ATTACHMENT.

By Joseph M. Levy, D.D.S., New York City, N. Y.

IN BRINGING the subject matter of my paper to your attention, I do so with the hope that it may help you, as it has me, in solving some of the problems of removable bridge work.

The method I will endeavor to explain to you is simple and direct and should give the operator a finished piece in two sittings.

The attachment used was originated by my laboratory director, Mr. John Yirikian, after we had had considerable difficulty with the other attachments on the market and in over eighteen months of use has never failed us.

The Yirikian split attachment consists of a female box portion which is circular for the greater part with a narrow groove cut out of the wall, the groove being about one fifth of the circumference of this wall. This groove, in some of the attachments, is extended for a distance about equal to its width. (Figure 1, A). This form of female attachment is of use in teeth which have either been devitalized or where the cavity is of sufficient depth to allow of its use without encroaching upon the pulp chamber. For use in vital teeth, where conservation of tooth structure is necessary for pulp protection, the groove in the female box portion of the attachment is not extended at all. (Figure 1, A^1).

The male portion of the Yirikian attachment consists of a split bar of 20% iridio-platinum, having a cylindrical head. This head is tapered from above downward so that as this portion of the attachment goes to place in the female box portion, the frictional engagement becomes greater the lower the male portion goes. When a bridge is found to be swinging on the abutments instead of resting on the ridge, due to shrinkage of the ridge and membranes from pressure, the lower surface of the male part of the attachment may be disced away sufficiently to again secure proper resting on the ridge. (Figure 1-B).

The attachment comes in various sizes and shapes to correspond with the varying conditions calling for its use. The No. 1 attachment is for use where very little space can be obtained without imperiling the pulp. The No. 2 where we have more room, the No. 3 where we have a close bite and the tooth used for the abutment has been devitalized, the No. 4 for use in devitalized incisors, the No. 5 where Goslee, Steele posterior or English tube teeth are to be used. (Figure 1).

In conjunction with the Yirikian attachment, we find the Yirikian parallelometer of inestimable value. This need not be described as it can readily be understood from an examination of the slide I will now show you. (Figure 2).

I will now explain to you in detail the various steps in the making of a

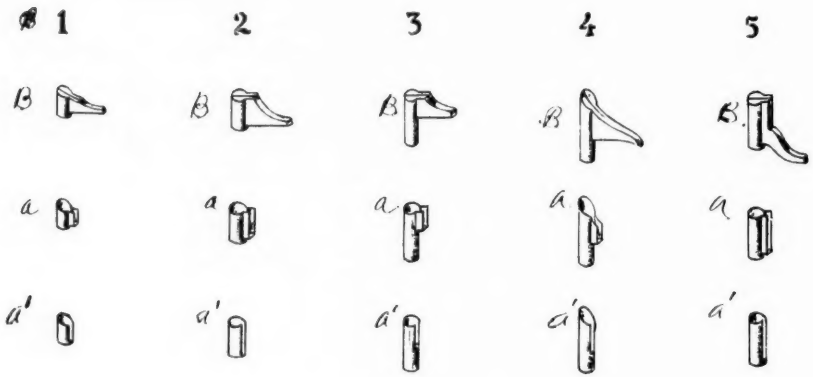


Figure 1.

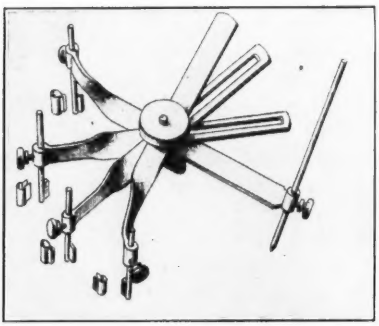


Figure 2.

Figure 4.

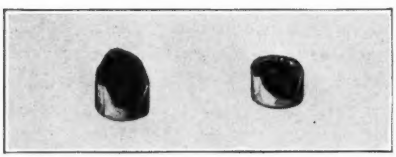


Figure 3.

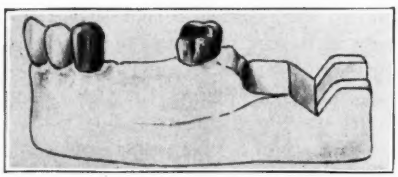


Figure 5.

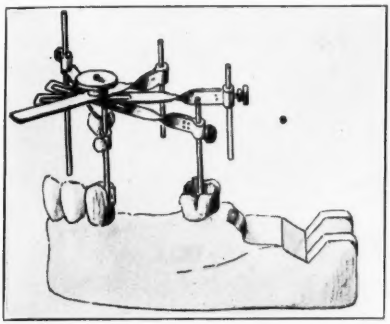


Figure 6.

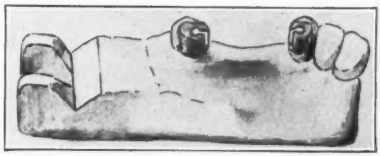


Figure 10.

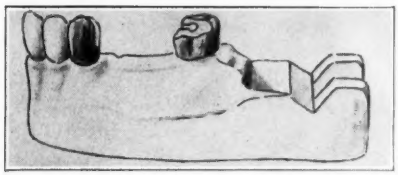


Figure 7.

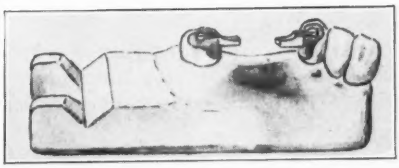


Figure 11.

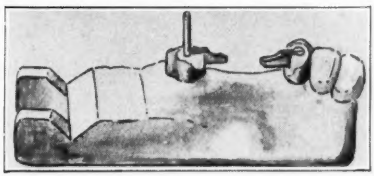


Figure 8.

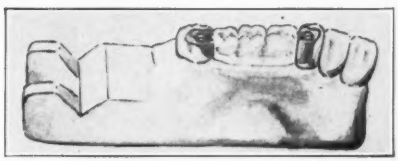


Figure 12.

Figure 9.

Figure 13.

bridge and will show you slides of each step in the construction. The bridge I am describing is one we made for a patient of Dr. Charles M. Proctor of this city, thru whose kindly interest the patient has come here this evening in order that you may have the opportunity of seeing a finished piece in the mouth.

The teeth to be supplied are the upper right first and second bicuspids and first molar. Teeth used as abutments, right superior cuspid and second molar, both of which are vital.

Step No. 1. Proper cavities for the inlay abutments having been prepared mesio-approximally in the second molar and disto approximally in the cuspid, good sharp impressions were taken in Detroit modelling compound. (Figure 3). At the same time a sharp wax bite was taken. This bite was thoroly chilled before removing.

Step No. 2. These impressions were packed with copper amalgam (we use Amess) and allowed to harden over night.

Step No. 3. The hardened dies and impression material were placed in warm water to soften the compound which was removed from the dies. The latter were then carefully trimmed to cavity margins, crossed marked with groove on their under sides and accurately placed in their proper positions in the wax bite. (Figure 4).

Step No. 4. The bite and articulation was now poured and separated (Figure 5).

Step No. 5. The dies having been oiled to facilitate the removal of the finished wax carving, and using the Yirikian parallelometer, the female portions of the attachments were waxed into position in the dies. (Figure 6).

Step No. 6. The male portions of the attachments were now oiled and placed in position in the female portions and the inlay carvings completed, building up proper occlusal and contact points. The male portions of the attachments are placed in position so that their presence while completing the carving will prevent wax being forced or dropped into the female portion which after casting would necessitate considerable labor to remove the gold which had taken the place of the wax. (Figure 7).

Step No. 7. Sprue formers were now attached (Figure 8) and the carvings removed from the dies.

Step No. 8. The carvings were now mounted as shown (Figure 9) invested and cast.

Step No. 9. The inlay castings were then finished on the dies. Before being polished they were swaged home.

Step No. 10. The finished inlays were then returned to Dr. Proctor, who placed them in their respective positions in the teeth, took a good sharp bite which was thoroly chilled before removing. With the inlays again in their positions in the teeth a sharp plaster impression was then taken, carrying the inlays away in the impression. The shade for the teeth was also taken at this sitting.

Step No. 11. A plaster model was now made from the impression, the inlays being in their proper positions in the impression naturally are found in their proper positions in the model. (Figure 10).

Step No. 12. The plaster model was then articulated.

Step No. 13-22K backings having fitted to the Steele facings selected for the case, these facings with their backings fitted were ground to place.

Step No. 14. The model was now thoroly oiled and the male portions of the attachments put into place, (Figure 11), bird shot rolled to 30 B & S gauge, first having been dropped into the circular portions of the female part of the

Figure 14.

Figure 20.

Figure 21.

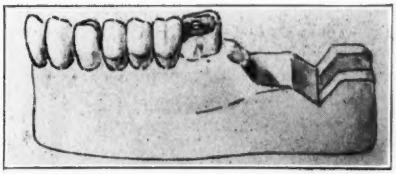


Figure 15.

Figure 22.

Figure 23.

Figure 16.

Figure 17.

Figure 24.

Figure 25.

Figure 18.

Figure 19.

Figure 26.

Figure 27.

Figure 28.

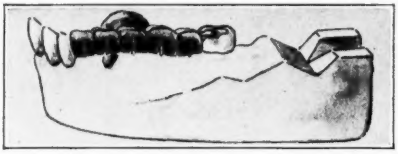


Figure 31 A.

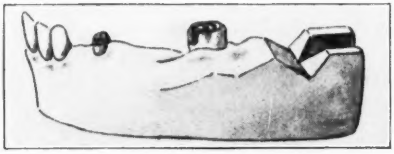


Figure 29.

Figure 31 B.

Figure 30.

Figure 31 C.

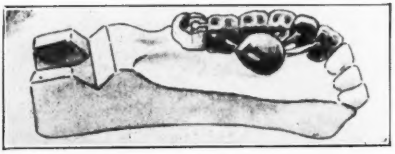


Figure 31.

Figure 31 D.

attachments. This is done to allow for the shrinkage of the membrane and ridge under the pressure of the bridge.

Step No. 15. The case was now waxed up, backings, attachments, etc., all being in positions. Saddle and occlusion all being provided for. (Figure 12).

Step No. 16. The facings having been removed, the wax carving for the bridge carrying the backings and male portions of the attachments was removed from the model. (Figure 13) invested and cast.

Step No. 17. The cast bridge was then returned to and finished on the model (Figure 14).

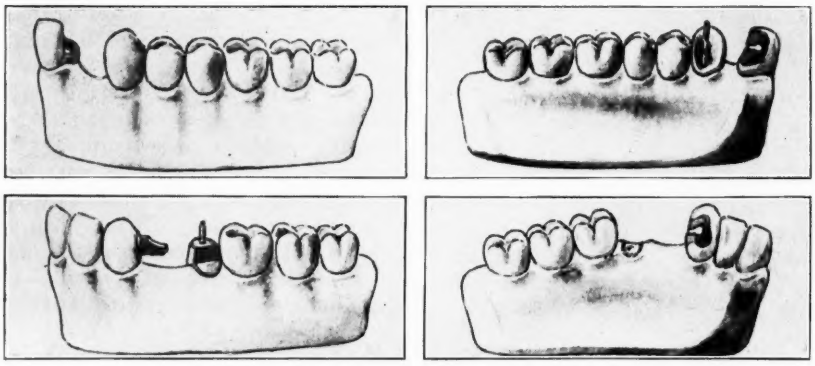
Step No. 18. The facings were then cemented in position and the case sent on to Doctor Proctor. (Figure 15).

Step No. 19. Doctor Proctor cemented the inlays in their respective cavities and inserted the bridge.

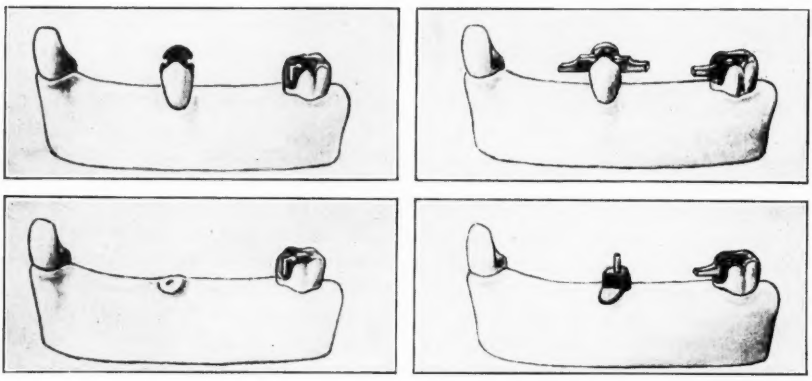
This technic in detail is the one to be followed in making any bridge using inlay abutments whatever the number of abutments. As it is not always possible to use inlay abutments, we have devised two other forms of abutments which, in conjunction with the inlay abutment answer all requirements.

One is a cast crown carrying the female portion of the attachment, the other a telescoping crown, using a split pin and tube. I will now give you the details of the technic in the making of these two forms of abutments and then show you slides of a large case, now in use over a year, where we used a telescoping crown as one and an inlay as the other abutment. I will then show you slides of a few simple models showing the adaptability of these combinations, asking you to bear in mind that these combinations could be multiplied considerably. In preparing a root for a cast crown, the canal is enlarged to receive a 16 B & S guage 20% iridio-platinum pin and at the same time a small box is cut in the upper portion of the root. (Figure 16). The pin is now placed in position and a sharp impression taken with Detroit modelling compound. (Figure 17). This is packed with copper amalgam, first having flowed wax over the platinum pin to prevent its amalgamation with the die. The amalgam is allowed to harden over night. The die is then removed from the compound as stated in step No. 3. After carefully trimming the die (Figure 18), it is accurately inserted in its proper position in the wax bite, having first been crossed marked on the bottom, and the bite poured and articulated. A Steel facing, having a 22k backing fitted, is now ground to place and the crown carved to contact and occlusion in inlay casting wax. (Figure 19). Having removed the porcelain facing, the wax carving carrying the backing and pin is now invested, cast and finished. (Figure 20). If the cast crown is being used as an abutment for a removable bridge, the female portion of the Yirikian attachment is waxed into position as described in Step No. 6. These steps are all taken at the same time the other abutment or abutments are being prepared so that the castings for the abutments are all done at one time and upon the first model obtained for the making of the bridge.

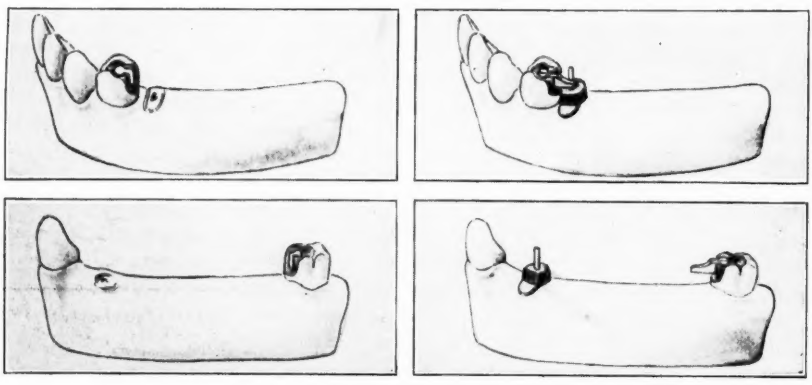
The root preparation for the telescoping crown requires the enlargement of the canal to receive the tube for the split pin. (Figure 21). Having thus prepared the root, the tube and pin being in position a sharp impression is taken in Detroit modelling compound. (Figure 22). From this a die is made as previously described. (Figure 23). Where plenty of room is had for the tube, it is only necessary to wax up a flat floor but where it is impossible to obtain sufficient room for paralleling the proper length of



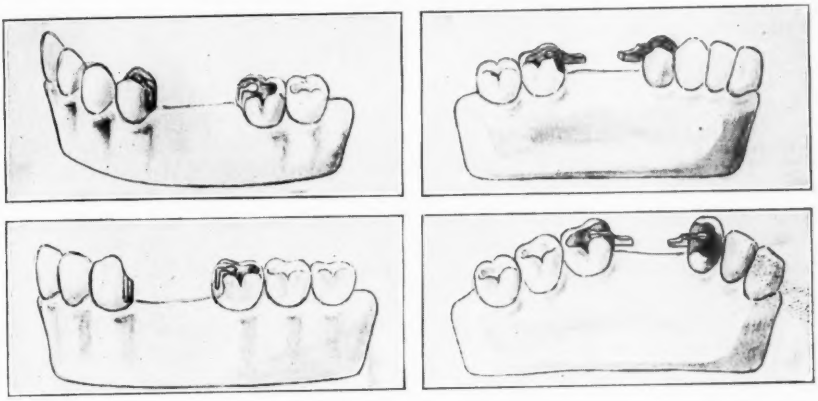
A.



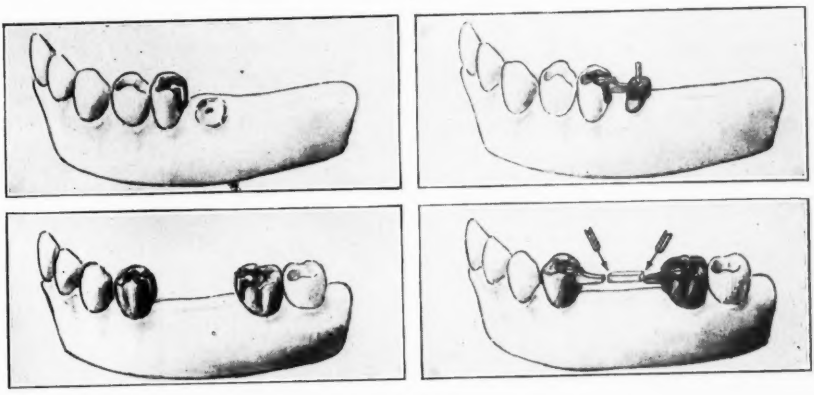
B.



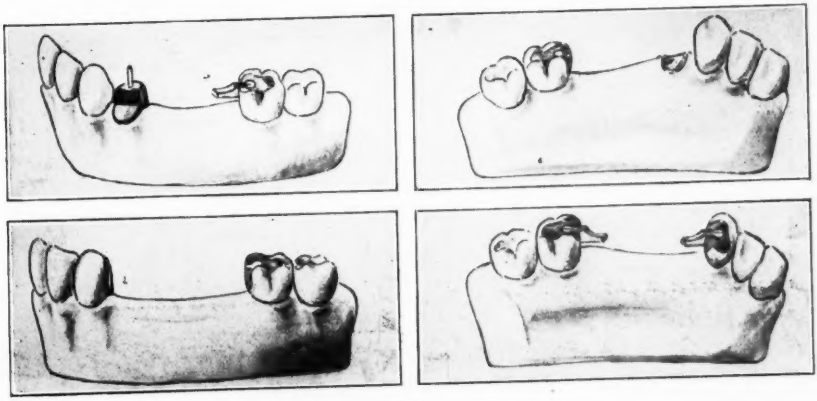
C.



D.



E.



F.

tube in the root, we wax the tube higher and carve a telescope floor as shown in Figure 24. The tube and wax carving are now removed from the die, invested and cast and finished on the die. Having finished the floor, a steel facing having a 22K backing fitted is now ground to place, the crown waxed to contact and occlusion. (Figure 25.) The porcelain facing is now removed from the backing and the waxed telescoping portion removed from the finished base (Figure 26) mounted by means of sprue form attached as shown in Figure 27, invested, cast and finished. (Figure 28).

In using this form of crown in conjunction with an inlay or cast crown abutment, only the base or flat floor is made and cast from the first model. This base of floor is placed in position in the mouth with the finished inlay or cast crown abutment and carried away in the plaster impression as described in Step No. 11. The telescoping portion is carved up and cast as one with the bridge carving.

Figure 29 shows the telescoping base and inlay abutment in place on the model of the large case mentioned some time ago. This case when finished extended from the upper right lateral to the upper right third molar. Figure 30 shows the finished wax carving for the bridge and Figures 31,31A,31B,31C and 31D show the casting of this bridge as it came from the investment unfinished. This large rough casting going home to place on the plaster model with the pin fitting accurately into the tube, demonstrates that the possible shrinkage, about which we have heard so much, could not equal one thousandth of an inch; for the difference between the external circumference of the pin and the internal circumference of the tube is just this much.

The rest of the slides show a few of the various combinations possible using these attachments and abutments.

The Research Department
CONDUCTED BY
THE RESEARCH INSTITUTE OF
THE NATIONAL DENTAL ASSOCIATION
CLEVELAND, OHIO

WESTON A. PRICE, M.S., D.D.S.,
President

SAMUEL E. POND, B.H., A.M., *Acting Research Director*

ELECTROLYTIC MEDICATION.

(Physiological and Dental Aspects.)

By Samuel E. Pond and Weston A Price.

(From the Laboratories of the Research Institute of the National Dental Association, Cleveland, Ohio.)

INTRODUCTORY.

DURING the past year S. C. Brooks and the writers, working in the Research Institute laboratories in Cleveland, have attempted to throw light upon some very important questions which have arisen in the practice of the so called "Electrolytic Medication." The purpose of this and succeeding papers is to study the action of electrolytes and electric current upon bacteria and body tissues under conditions simulating the treatment of infected oral tissues in the human body. It is hoped in this way to aid the dental profession to clear away some misconceptions regarding "Electrolytic Medication" and to more readily establish such a therapeutic method upon a firm basis.

The treatment of various diseases and diseased areas by medicaments carried into the tissues thru the aid of a galvanic current has been known, in dentistry, as "Cataphoresis" (W. J. Morton), "Ionic Medication" (Jones), "Electrolization" (Rhein), "Electro-Sterilization" (Prinz), "Electrolytic Medication" (Fette), and "Iontophoresis" (Köller). There has been no uniform choice of any one of these terms. Indeed, tc select one descriptive of the method is somewhat arbitrary, depending largely upon the conception of what takes place. Since the diffusion of ions in a mean direction (not specifically toward the cathode) is considered the important factor, and not always to effect sterilization but, as well, the stimulation tending toward the regeneration and repair of periapical and other tissues we may suggest, that the

term "Electrolytic Medication" appears to be satisfactory and the most applicable of those which have been used. Fette has previously indicated (1) that the term "Electrolytic Medication" is preferable to "Ionic Medication" or "Ionization" as it implies a method of treatment with an electrolyte and that electrolysis (not alone "Ionization") is one of the associated phenomena. The term may not be wholly applicable but it appears to more nearly approach a descriptive one and be less confusing than the others referred to. We shall use, in this paper, electrolytic medication synonomously with the phrase electro-chemical method, and discriminate between the names of associated phenomena, e. g. dissociation, electrolysis, polarization, etc.

The use in dentistry of galvanic current and externally applied medicaments was suggested in 1858 by B. W. Richardson. In 1887 Dr. McGraw demonstrated, at a clinic in Chicago, some apparatus in this connection. In 1895 Gillett, one of us (Price), Van Woert, and others, perfected apparatus and studied what was then known as "Cataphoresis." L. P. Bethel, W. J. Morton, M. L. Rhein, E. Sturridge, and others, treated pyorrhea and attempted from 1896 on to correct various septic conditions with the aid of this agent. In 1903 Hoffendahl, after working with Miller in Germany, recommended that electricity be used without externally applied electrolytes. Since then, in this country and abroad, considerable prominence has been given to the use of electricity with and without externally applied electrolytes to cure and correct certain abnormal or pathological conditions, i. e., to sterilize infected tissues and to stimulate and lead to the replacement of tissue destroyed as a result of infection.

An electro-chemical method has been advocated for various reasons. One of the chief of these is apparently the aim to reach deep seated infections with different medicaments which, it has been assumed, could be driven into the tissues to "seats of infection" by an easily controlled reagent, electricity. Some of these medicaments have disinfecting properties but, what is essential to note here, the combination of electrolytes and electric current has been definitely credited by Prinz (2), and perhaps others, with having sterilized infected areas, (presumably by direct action upon the bacteria). Some articles on this subject have, also, given the writers of this paper the impression that electrolytic medication has led to the stimulation of the body tissues to repair destroyed portions.

The usual treatments with electrolytic medication vary considerably. They involve the use of a galvanic current with an approximate range of one-tenth milliampere to five milliamperes, over a period of from five to forty-five minutes. Electrodes of copper, zinc, platinum, silver and iron have been used with either anode or cathode in the tooth. An "indifferent" (larger) electrode serving as the opposite pole is placed by some operators on the gum near the tooth to be treated, by others on the cheek, back of the neck, on the forehead, or on either wrist. The electrolytes which have been recommended and used are copper chloride, copper sulfate, magnesium chloride, potassium iodide, sodium chloride, silver nitrate, zinc chloride, zinc sulfate and possibly others. Iodin in alcohol and in water has also been recommended in connection with electrolytic medication but the halogen is not an electrolyte, i. e., does not conduct electricity to any appreciable extent. Studies to determine the effect of differences of potential, current density, the value of one electrode over another, or the superiority of an electrolyte for a specific purpose have not been prosecuted extensively enough to satisfy the writers. This fact along with the variety of technic, the great differences of

(1) Journal of the National Dental Association, March 1917.

(2) Prinz, H. "Electro Sterilization," Dental Cosmos, April 1917, page 373.

opinion among the profession and some conflicting clinical data which we have secured, has led us to undertake the present work. The clinical data included the culturing of the fluid from the periapical area in a large number of cases, including immediate aspirations, one hour after, and one and several days after, electrolytic medication, and in each and every case we obtained vital cultures. These clinical tests also included the extracting of a tooth and the culturing of its root apex and the periapical tissues after the treatment had been given for thirty minutes at 4 ma. The current was again applied to this tooth, after extraction, for one hour at a higher current strength in a normal salt and the apex still gave vital cultures.

A study of the literature on this subject has involved the construction of a bibliography, based mainly upon the review of twenty different dental journals (cf. "Bibliography of Electrolytic Medication"). The oldest of these journals have been reviewed since 1881 and the rest since their beginning. In many cases the indexing has been found to be so poorly done that volume after volume has had to be scanned serially. The result has been the review of the development of the method, the gaining of a quite definite idea as regards the present standing of electrolytic medication and the recognition of the complexity of the problem. Besides the dental literature we have frequently referred to the medical journals, and those of the more exact sciences, especially physical chemistry, for recent contributions to the subject and original investigations. From this review we have been impressed with the need of an analysis of the whole problem and have, consequently, conducted the experimental work and considered the theoretical aspect under the following four divisions:

A. Direct Effects.

1. *Toxicity of electrolytes,* to answer the questions (a) What concentration of electrolytes, acting for a unit time, are toxic so that they cause irreversible changes, i. e., death of bacteria? (b) In these concentrations for the same unit of time, is there destruction of human tissue beyond the limit of body tolerance and power of regeneration?

2. *Effect of galvanic current upon living tissues,* to answer (a) Will galvanic currents kill pure or mixed cultures of bacteria and what is such an irreversible change a function of (i. e. time, current-density, electromotive force, etc.)? (b) What is the effect upon human tissues of a galvanic current acting under conditions which will kill bacteria in that locus?

3. *Electro-chemical effects,* to throw light upon (a) What effects are produced when electrolytes are used in connection with galvanic current upon bacteria and upon human tissues under conditions which would kill bacteria and under conditions simulating the present practice with regard to electro-sterilization of root canals and periapical tissues? (b) What is the depth to which the ions penetrate under a fall of potential which is used in connection with electrolytic medication, and what is the penetration a function of?

B. Indirect Effects.

4. *Tissue repair factors,* to answer (a) What are the essential factors in the repair of periapical tissues? (b) Can electric current, or electrolytes, or both, change dying cells to recuperating or living cells?

General Considerations.

Before proceeding to the presentation of the experimental data regarding the action of electrolytes and electric current on tissues, the writers believe that it is necessary to consider some general and related questions.

It has been intended in this paper to point out the value of quantitative determination and care in the recording of experimental results. To aid in making this clear, the analysis of the prob-

lem includes largely the determination of certain quantitative factors with which we are especially concerned. To put this view in other words, we believe that it is not sufficient to know *what* changes take place, but also *how* they take place and how one factor is *related* to another, in a given reaction. The medical profession has already realized the necessity for quantitative methods in research. Recently, for example, studies on the "rate of cicatrization" have been reduced to mathematical expression by Carrel, DuNouy, and others (3). The subject of immunity, or immunization, probably better known to the dental profession, is being developed more rapidly since the quantitative studies of Madsen and Jorgensen on the blood's content of agglutinin and Levin's studies on the concentration of diphtheria antitoxin in goat's blood (4). In dentistry Prinz (5) has proposed, altho with unreliable data, an expression to calculate the time of current application in "Electro-Sterilization." It is essential, we wish to point out, that this need of quantitative expressions be more fully realized in dentistry.

In this connection Arrhenius (4) wrote

> "As long as only qualitative methods are used in a branch of science, this cannot rise to a higher stage than the descriptive one."

His point may be taken as implying that medicine today consists of countless descriptions of known diseases, observations of the treatments, of drugs used, and the clinical results, and to form an opinion of the manner in which these substances react it is essential to utilize the methods introduced by modern physical chemistry. Descriptive and qualitative chemistry are of very limited value. Physical and theoretical chemistry allow us to follow quantitatively the influence of temperature and of foreign substances upon the interesting organic products; which are of greatest importance in medicine, in the physiological processes of daily life and in the diseases and their therapy. Biological chemistry and general physiology in applying the physico-chemical methods have paved the way to a clearer understanding of the vital processes upon which is based the advance in medicine. The literature reviewed for this study indicates that the dental profession has not realized the significance of care in the recording of results and of quantitative measurements.

There have been a few notable exceptions to the last statement. We would refer here to the studies in metallurgy, cocain anesthesia, teeth stains, and, recently, the studies with relation to bacteria and the internal secretions. With reference to the problem of electrolytic medication, the early observations and conclusions from studies in cataphoresis 1895-1900, regarding the chemical and physical factors, have, however, passed unimproved and untested in spite of the fact that investigations in medicine and physiology destroy, to a great extent, the value of these old results and must change, as will be later seen, our concept with regard to such phenomena.

In the main the investigators of the question of "Electro-Sterilization" and those who have striven to perfect technic in the application of such a method have neglected, furthermore, to appreciate fully the significance of characteristic differences between living and non-living systems. A knowledge of electricity, deemed important by Sturridge (6) and many others (7), and even a knowl-

(3) Carrel and Hartman, Jr. Experimental Medicine, '16, XXIV, 5,429; DuNouy, Ibid, 451; Same XXV, 5,721; Vincent, Ibid XXVI, 1,83.

(4) Arrhenius, Immunochemistry, N. Y. 1907, Macmillan; Madsen and his pupils "Memoirs in the Communications de l' Institute serotherapione de l' Etat danois 1907-13.

(5) Prinz, Cosmos, LIX, 4,393, April 1917.

(4) Arrhenius, Quantitative laws in Biological Chemistry, London, 1915, G. Bell and Sons, Ltd.

(6) Sturridge, E. "Dental Electro-Therapeutics," Lea and Febiger, N. Y. 1914.

(7) Tousey, Sinclair, "Medical Electricity"—Saunders, 1915; Jones, Lewis. "Ionic Medication," Blakiston, 1914, 2d ed.; Fette, G. T., Cosmos, March 1917, and this Journal, March, 1917.

edge of electro-chemistry, is not sufficient. Electrical response in living tissue, the role of electrolytes, polarization phenomena, the significance of the semi-permeability of membranes, surface-tension, etc., have not been considered sufficiently in the past when drawing conclusions as to the efficacy of such an application of electro-chemical phenomena as an "Electrolytic Medication." In 1900 Cook, A. Pont, and one of us (Price), discussed the significance of certain of these physiological questions. No further consideration of such matters has been prominent in the dental literature.

With living matter, we must not overlook the fact that we are dealing with two types of reactions, (known in chemistry as the "reversible" and the "irreversible"). The characteristic of the living state is that reactions are not in stable equilibrium and are largely of the reversible type. For example, we are not dealing with reactions as

$$H_2+\tfrac{1}{2}O_2=H_2O \text{ or } NaOH+HCl=NaCl+H_2O$$

but more of the type

$$C_2H_5OH+CH_3.COOH\rightleftarrows CH_3.COOC_2H_5+H_2O$$

(the last known as "esterification" and "saponification"). The reactions in the body further, have been considered, by some investigators, as similar to the change in gelatine from solution to jelly and the reverse (sol⇄gel). In the body we presume that changes occur constantly in one or the other direction, hence we speak of them as reversible. In a large measure the effect of electrolytes and electric current upon the living cells leads to the type of *reversible reactions* (such as alterations in the semi-permeability of membranes, temporary changes of the hydrogen-ion concentration, narcosis, or anesthesia, and the like). In physical and organic systems an increase in the tensity of such reagents or a longer reaction time will often lead to *irreversible changes;* resulting, in the body, in the destruction or death of the tissue. This statement applies to bacteria as well as to body cells.

It will be worth while to point out some of the reactions of this type with which we are concerned in this connection. Constant electric current, e. g. galvanic electricity, passing thru the living organism, alters many physiological processes. Where the current enters the tissue (in the region of the anode) there is decreased irritability, depression, or inhibition ("anelectrotonus"); where the current leaves the tissue (the region about the cathode) there is excitation or heightened irritability ("catelectrotonus").

"The essential basis of the effect appears to be an altered polarization of the cell surface" (Lillie) (8).

Reversible changes in the semipermeable membranes and other secondary effects are known to accompany this polarization effect in many cases. This is attributed by Nernst to the accumulation of the ions of the dissolved electrolytes of the cell at the membrane, under a constant fall of potential.

As regards the actions of ions and molecules of electrolytes in contact with the living cell there are many characteristic effects of the reversible type. Magnesium sulfate is known to produce anesthesia. Similar effects are produced by potassium salts. Calcium and strontium salts cause reversible desensitization in nerve and muscle. (Lillie, above) Calcium, also, antagonizes the stimulating action of pure sodium salts, hence its use in Ringer's and Locke's solutions.

Considerable significance is attached to the effect of the neutral salts upon the colloids of the cell, especially of the surface layer or plasma membrane, (probably a solution effect or surface tension change.) Czapek, Osterhout, Macallum, Lillie, Höber, Overton, and others, have studied the effects of electrolytes and, as well, other chemicals

(8) Lillie, R. S. Biological Bulletin, Vol. 5,311, May 1916.

upon the surface membranes. Some of the effects were found to accompany an increase or decrease of the surface tension and are closely connected with the electrical potential difference existing between colloidal (or other cell particles) and the medium by which the cell is bathed. The significance of this surface effect, of alterations of the semi-permeability of the plasma membranes, is important. Lillie considers that "a surface effect is sufficient to set in motion the whole complex apparatus of response in the cell-interior."

Whatever effects have been produced during electrolytic medication are apparently, we believe, of the reversible type. In other words, electrolytes or electric current in low concentrations or for brief periods of time may intensify or suppress certain functions. Presumably, however, increase, either in the intensity of the reagent or the amount of reaction time, should lead to irreversible destructive changes. Our experiments indicate this irreversibility in reactions with bacteria has not been secured. The reversibility or irreversibility, it must be noted, is the same in character with living cells of whatever type or function, i. e. bacteria, epithelial, bone, or other cells, differing only in degree, due probably to different rates of metabolism, or to constitution, characteristic of the individual cell.

A. Direct Effects.

1. Action of Electrolytes upon Bacteria and Other Organisms.

Studies of electrolyte action on bacteria have been made necessary because investigations in the past have not taken into account (1) exact quantities of the reagents, (2) the time over which the reaction was allowed to take place, or (3) the conditions were not comparable with those which we meet in electrolytic medication. For instance, many of the investigators working with bacteria "in vitro" allowed the electrolytes to act for twenty-four hours. It is essential for our purpose to know what direct action there is in every minute, or at least after five, fifteen and thirty minutes.

For this purpose, a series of electrolytes (chlorides and sulfates of eleven different elements) were selected and used in different concentrations for different periods of time.

Saturated and ten per cent (a) solutions were made up at twenty-five degrees centigrade. One per cent and one-tenth per cent solutions were made up from the latter by diluting a pipetted sample (i. e. ten cc and one cc respectively) to one hundred cubic centimeters at the same temperature. (b)

The procedure was to use one-half cubic centimeter of each salt or acid solution and an equal quantity of an active culture of mixed oral bacteria in dextrose agar broth. (Hence, there was a total concentration of one-half that made up.)

Certain experimental errors, it is hoped, were avoided in this series. Every precaution was taken in the series to prevent contamination of the salt and acid solutions as we were attempting to study the direct action of pure electrolytes. The culture of bacteria was grown fresh and was used within twenty-four hours. A freshly extracted infected tooth was ground up in a mortar and mixed with a sterilized dextrose agar broth, about one quarter of a liter. In twelve hours, at thirty-seven and one-half degrees centigrade, an active culture was observed in every case. The mixture of electrolyte and bacteria was placed in small test tubes and kept thruout the reaction time at constant temperature, thirty-seven and one-half degrees centigrade. After five minutes had elapsed a sample on a flam-

(a) Ten grams by weight diluted with distilled water to one hundred grams of solution.

(b) We have used "per cent" concentrations because this term occurs in the dental literature on this subject. We have calculated all of the concentrations in terms of the molecular weight in a liter of solution. It is to be hoped that in dental research of the future, investigators will utilize the latter (molecular) concentrations and, as well, the chemical equivalent (normal) concentrations, terms used by the analytical chemist. It would then be possible without difficulty to recognize equivalent chemical action, and compare, readily, results from different hands.

TABLE I.

Action of Electrolytes on Bacteria in Mass.

	REAGENT	M. W.	CONCENTRATION SOLUTION P. C.	CONCENTRATION ACTING P. C.	CONCENTRATION MOLAR
1	$Al_2K_2(SO_4)_4$ 24 H_2O	516.68	11.4	5.7	0.11
2	"		10.0	5.0	0.097
3	"		1.0	0.5	0.009
4	"		0.1	0.05	0.001
5	$Al_2(NH_4)_2(SO_4)_4$. 24 H_2O	474.48	15.15	7.575	0.159
6	"		10.0	5.0	0.105
7	"		1.0	0.5	0.010
8	"		0.1	0.05	0.001
9	$CuSO_4$. 5 H_2O	249.57	17.4	8.7	0.349
10	"		10.0	5.0	0.200
11	"		1.0	0.5	0.020
12	"		0.1	0.05	0.002
13	Fe SO_4. 7 H_2O	277.84	21.0	10.5	0.378
14	"		10.0	5.0	0.180
15	"		1.0	0.5	0.018
16	"		0.1	0.05	0.002
17	H_2SO_4	98.0	96.0	48.0	4.786
18	"		10.0	5.0	0.51
19	"		1.0	0.5	0.051
20	"		0.1	0.05	0.005
21	K_2SO_4	174.2	10.0	5.0	0.287
22	"		1.0	0.5	0.029
23	"		0.1	0.05	0.003
24	$MgSO_4$. 7 H_2O	246.32	26.2	13.1	0.537
25	"		10.0	5.0	0.203
26	"		1.0	0.5	0.020
27	"		0.1	0.05	0.002
28	$ZnSO_4$. 7 H_2O	187.37	36.67	18.335	0.978
29	"		10.0	5.0	0.267
30	"		1.0	0.5	0.026
31	"		0.1	0.05	0.003
32	Al_2Cl_6. 12 H_2O	376.58	41.0	20.5	0.544
33	"		10.0	5.0	0.133
34	"		1.0	0.5	0.013
35	"		0.1	0.05	0.001
36	$CaCl_2$. 6 H_2O	218.99	42.7	21.35	0.979
37	"		10.0	5.0	0.248
38	"		1.0	0.5	0.025
39	"		0.1	0.05	0.003
40	CuCl. 2 H_2O	152.49	43.1	21.55	1.418
41	"		10.0	5.0	0.330
42	"		1.0	0.5	0.038
43	"		0.1	0.05	0.003
44	$FeCl_6$. 12 H_2O	540.44	47.9	23.95	0.443
45	"		10.0	5.0	0.093
46	"		1.0	0.5	0.009
47	"		0.1	0.05	0.001
48	HCl	36.46	32.0	16.0	4.388
49	"		10.0	5.0	1.372
50	"		1.0	0.5	0.137
51	"		0.1	0.05	0.014
52	$HgCl_2$	271.52	6.8	3.4	0.125
53	"		1.0	0.5	0.018
54	"		0.1	0.05	0.002
55	KCl	74.56	25.5	12.75	2.153
56	"		10.0	5.0	0.671
57	"		1.0	0.5	0.067
58	"		0.1	0.05	0.007
59	$MgCl_2$. 6 H_2O	203.24	35.0	17.5	0.861
60	"		10.0	5.0	0.246
61	"		1.0	0.5	0.025
62	"		0.1	0.05	0.002
63	NaCl	58.46	26.0	13.0	2.224
64	"		10.0	5.0	0.855
65	"		1.0	0.5	0.086
66	"		0.1	0.05	0.009
67	NH_4Cl	124.38	27.0	13.5	1.086
68	"		10.0	5.0	0.412
69	"		1.0	0.5	0.041
70	"		0.1	0.05	0.004
71	$PbCl_2$	278.02	0.96	0.48	0.017
72	"		0.1	0.05	0.002

TABLE I (Continued.)

ACTION OF ELECTROLYTES ON BACTERIA IN MASS.

	REAGENT	M. W.	CONCENTRATION SOLUTION P. C.	CONCENTRATION ACTING P. C.	CONCENTRATION ACTING MOLAR
73	$ZnCl_2$ H_2O	154.29	79.8	39.9	2.586
74	I (Alc)) Control	126.92	7.0	3.5	
75	") in		1.0	0.5	
76	") Alcohol		0.1	0.05	
77	I (Water)		0.027	0.013825	0.0011
78	KI	166.02	59.0	29.5	1.777
79	"		10.0	5.0	0.301
80	"		1.0	0.5	0.030
81	"		0.1	0.05	0.003

ed platinum loop, or tungsten-gold wire, was transferred to each of four tubes of sterile dextrose agar broth. This was also done after fifteen, thirty, sixty and one hundred and twenty minutes. Controls with the solvent of the electrolyte, in this case water, were used in every case. Observations of the incubated samples were made after twenty-four and forty-eight hours, and in some cases four days. If, in this incubation time, a tube was still clear it was called negative. (See Table II). Controls in every case indicated (cloudy tube) that the growth of bacteria was active and alive thruout the longest reaction period of over two hours, under the same conditions as the electrolyte-bacteria reaction was proceeding.

The results are significant. The following decreasing order of toxicity was recorded for neutral salts:

Mercury>Iron>Copper> Aluminum

With the acids which were possessed of toxic properties, concentrated hydrochloric was slightly greater in effect than concentrated sulfuric. In the case of mercuric chloride of all concentrations used, i. e. saturated and as low as 0.002M, all the bacteria in the mixture were killed during five minutes. A saturated solution of ferric chloride was slightly effective after fifteen minutes and reached a maximum in about thirty minutes. No dilutions of the salt were effective. A saturated solution of copper chloride required one hour before it could be said to have a disinfecting action, and a saturated solution of copper sulfate required two hours. The saturated solution of aluminum chloride inhibited but did not prevent growth thruout two hours. Concentrated hydrochloric acid was effective as a disinfectant within five minutes, but ten per cent and one per cent solutions required one hour. The bacteria withstood the action of concentrated sulfuric acid for more than five minutes but were killed in something less than fifteen. Ten per cent solutions required two hours before they were effective. Lower concentrations of the reagents than those mentioned had no perceptible effect. There was no disinfecting, or even antiseptic action, with the following cations: Ammonium; calcium; ferrous iron; lead; magnesium; potassium; sodium and zinc. The anions chloride and sulfate exhibited no toxic properties.*

We are thus led to conclude with regard to the electrolytes in their direct action upon bacteria that, to disinfect or sterilize chemically, it would be necessary in the case of mixed cultures of bacteria to use concentrations which

*In regard to the terms antiseptic and disinfectant we follow the accepted use in bacteriology. The term antiseptic is taken to mean either neutralization of toxin or to inhibit bacterial growth, while disinfectant means to kill or cytolyze the bacteria and stop growth, permanently, of bacteria present.

RESULTS: # represents growth; · represents no growth.

	CONTROL MEDIA		0.5 c.c. INFECTED MEDIA 0.5 c.c. REAGENT									
			5M React'n		15M Reactn		30M Reactn		1Hr Reactn		2Hr React'n	
1	24 H	48 H	24 h	48 H	24 H	48 H	24 H	48 H	24 H	48 H	24 H	48 H
1	####	####	####	####	####	####	####	####	####	####	####	####
2	####	####	####	####	####	####	####	####	####	####	####	####
3	####	####	####	####	####	####	####	####	####	####	####	####
4	####	####	####	####	####	####	####	####	####	####	####	####
5	####	####	####	####	####	####	####	####	####	####	####	####
6	####	####	####	####	####	####	####	####	####	####	####	####
7	####	####	####	####	####	####	####	####	####	####	####	####
8	####	####	####	####	####	####	####	####	####	####	####	####
9	####	####	####	####	####	####	####	####	#---	#---	#---	#---
10	####	####	####	####	####	####	####	####	##--	##--	##--	##--
11	####	####	####	####	####	####	####	####	####	####	####	####
12	####	####	####	####	####	####	####	####	####	####	####	####
13	####	####	####	####	####	####	####	####	####	####	####	####
14	####	####	####	####	####	####	####	####	####	####	####	####
15	####	####	####	####	####	####	####	####	####	####	####	####
16	####	####	####	####	####	####	####	####	####	####	####	####
17	####	####	####	####	----	----	----	----	----	----	----	----
18	####	####	####	####	####	####	###-	###-	##--	##--	----	----
19	####	####	####	####	####	####	####	####	####	####	####	####
20	####	####	####	####	####	####	####	####	####	####	####	####
21	####	####	####	####	####	####	####	####	####	####	####	####
22	####	####	####	####	####	####	####	####	####	####	####	####
23	####	####	####	####	####	####	####	####	####	####	####	####
24	####	####	####	####	####	####	####	####	####	####	####	####
25	####	####	####	####	####	####	####	####	####	####	####	####
27	####	####	####	####	####	####	####	####	####	####	####	####
28	####	####	####	####	####	####	####	####	####	####	####	####
29	####	####	####	####	####	####	####	####	####	####	####	####
30	####	####	####	####	####	####	####	####	####	####	####	####
31	####	####	####	####	####	####	####	####	####	####	####	####
32	####	####	####	####	####	####	###-	###-	###-	###-	####	####
33	####	####	####	####	####	####	####	####	####	####	###-	###-
34	####	####	####	####	####	####	####	####	####	####	####	####
35	####	####	####	####	####	####	####	####	####	####	####	####
36	####	####	####	####	####	####	####	####	####	####	###-	###-
37	####	####	####	####	####	####	####	####	####	####	####	####
38	####	####	####	####	####	####	####	####	####	####	####	####
39	####	####	####	####	####	####	####	####	####	####	####	####
40	####	####	####	####	###-	###-	##--	##--	----	----	----	----
41	####	####	####	####	###-	###-	###-	###-	##--	##--	###-	###-
42	####	####	####	####	####	####	####	####	###-	###-	##--	##--
43	####	####	####	####	####	####	####	####	####	####	####	####
44	####	####	####	####	##--	##--	----	----	----	----	----	----
45	####	####	####	####	####	####	###-	###-	###-	###-	#---	#---
46	####	####	####	####	####	####	###-	###-	###-	###-	##--	##--
47	####	####	####	####	####	####	####	####	####	####	####	####
48	####	####	----	----	#---	#---	----	----	----	----	----	----
49	####	####	###-	###-	###-	###-	##--	##--	----	----	----	----
50	####	####	####	####	####	####	###-	###-	----	----	----	----

TABLE II (Continued.)

RESULTS: # represents growth; - represents no growth.

	CONTROL MEDIA		0.5 c.c. INFECTED MEDIA 0.5 c.c. REAGENT									
			5M React'n		15M Reactn		30M Reactn		1Hr Reactn		2Hr Reactn	
	24 H	48 H	24 H	48 H	24 H	48 H	24 H	48 H	24 H	48 H	24 H	48 H
51	####	####	####	####	####	####	####	####	####	####	####	####
52	####	####	----	----	----	----	----	----	----	----	----	----
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would be prohibitive in connection with electrolytic medication. It would not seem wise to attempt to use about the teeth the concentrated hydrochloric or sulfuric acid which would be necessary to kill any large quantity of bacteria in a short period of time. Mercuric chloride is not advisable to use except externally, unless it can be reduced by the body to HgC1 (mercurous chloride or "calomel"). The time and concentration necessary to disinfect with ferric chloride or copper sulfate, for this reason, makes these electrolytes almost prohibitive. This statement of the case applies under the conditions which the bacteria were killed in these experiments. It is obviously impossible in practice to bring about the total concentration with which these results were obtained in these tests. The diffusion of a solution from the pulp chamber to the periapical or other tissues surrounding the teeth would require considerably longer time even with the electric current, and then it is doubtful if the distribution could be anywhere nearly as effective or uniform as in our experiments.

Referring to the work of others for comparison Krönig and Paul (9) found

(9) 1896—Zeitschr—Phys. Chem. 21, 414.

that the number of colonies of bacteria depended upon the time during which the toxic reagent acted and upon the concentration of the solutions. They found that the more dilute the solution the less was the action. They used pure strains of bacillus anthracis and staphylococcus pyogenes aureus distributed on garnets to insure uniform amounts of the flora. The only other results known to us which are comparable are those of Sternberg who used five cubic centimeters of reagent and five cubic centimeters of a bacterial culture in media, allowing the action, in every case, to proceed for two hours.* Sternberg found that the minimum concentration of five reagents required to kill bacteria was as follows: (10)

	HCl	NaOH	$AuCl_3$	$AgNO_3$	C_6H_5OH
Anthrax	1:1100	1:450	1:8000	1:20000	1:300
Diftheria	1:700	1:300	1:1000	1:2500	1:300
Glanders	1:200	1:150	1:400	1:4000	1:300
Tyfoid	1:300	1:180	1:500	1:4000	1:200
Cholera	1:1350	1:150	1:1000	1:4000	1:400

Boer (11) found that in two hours it required HCl in the following concentrations to kill:

Anthrax b.	1:1100
Diftheria	1:700
Glanders	1:200
Tyfoid	1:300
Cholera spir.	1:1350

Kitasoto (12) found HNO_3 required as follows:

Cholera spir. 35% HNO_3 5 hrs.
Tyfoid 35% HNO_3 5 hrs.

KOH was found to require

Pus cocci 10% KOH 2 hrs.
T. B. bac. 10% KOH 24 hrs. failed to kill.
Tyfoid 0.18% KOH 5 hrs. killed.

NaOH Kitasoto found to be the same as KOH.

While it is somewhat out of place in this discussion it will be well to mention here the action of chlorin as a disinfectant. Prinz (13) writes

"The ionization of a one per cent. sodium chloride solution by means of the galvanic current within a root canal furnished free chlorin in 'status nascendi' in the presence of moisture and body temperature which is most active, and admirably suited for our purposes. The free chlorin sterilizes the walls of the root canal—and bleaches the discolored dentin. Incidentally, the ionization of salt water furnishes an appreciable amount of hydrochloric acid which acts as a superficial solvent of tooth structure, and thereby enlarges the root canal."

From this quotation we might understand that the *chloride ion* is a disinfectant because of the author's use of the word "ionization." We believe, however, after careful inspection, that Prinz does not mean ionization, but electrolysis. Regarding the action of electrolytic products we will speak later under the head of electro-chemical action upon bacteria but we will here make clear the difference between the action of ionic (charged molecular or atomic) chlorin and gaseous (electrically neutral) chlorin. There is danger of confusion in the use of the terms, by authors in the dental literature.

The chloride ion as *dissociated* from any neutral salt or hydrochloric acid in water solution (that is, *ionic* chlorin) is not a disinfectant. Our experiments, for example, referred to above (where we used highly dissociable chlorides) exhibited no toxic reaction with bacteria. In all cases (in one series) the chloride ion (anion) was present and in suitable concentration to have disinfected, had the ion possessed that property. This result is in agreement with the findings of many investigators. The chloride ion (likewise the sulfate or nitrate ion) is

*Other investigators allowed the reaction to proceed for twenty-four hours and most of them introduced only an amount of bacteria which could be carried on a platinum loop into relatively large quantities of electrolyte solutions, thus making it difficult to compare results.

(10) Sternberg, G. M., Manual of Bacteriology, N. Y. 1893.

(11) Boer, cf. Sternberg loc. cit.

(12) Kitasoto, cf. Sternberg loc. cit.

(13) Prinz, H. Dental Cosmos, April 1917, page 388.

non-toxic. Plant and animal cells will live for days, in mixture of neutral salts (Ringer's or Locke's solution) where the anion is chloride (also true of sulfate or nitrate).

On the other hand, chlorin in gaseous or molecular (electrically neutral or non ionic) form is a disinfectant. It has an affinity for hydrogen and releases nascent oxygen. It must act, however, in the presence of moisture, as Prinz indicated.* We may illustrate here that anthrax spores, which had been previously dried and exposed to 44.7 per cent dried chlorin were not destroyed. Moistened spores were killed in the same time with four per cent chlorin. (10)

We do not understand how "ionization" of a sodium chloride solution will liberate chlorin in such a form that it will disinfect. It must be understood that "nascent" chlorin (indicated by Prinz) refers to the gas and not to the ion, and ionization does not produce the former, but the latter. It is the former upon which the action of the hypochlorite solution, suggested by Prinz,* depends for its disinfecting property and we wish to point out here that this action is not direct but in reality by a secondary or indirect reaction. The Dakin-Daufresne hypochlorite solution is slightly soluble in water and yields $Ca(^{++})$, $Cl^{(-)}$ and $(ClO)^{(-)}$ ions. In the presence of catalizers the hypochlorite solution would decompose as follows:

hypochlorite

$$2\ CaCl\ (OCl) \rightarrow 2\ CaCl_2 + O_2$$

The germicidal action of the hypochlorite solution is dependent, according to Dakin, upon the formation of a chloramine group (NCl) (14) which is strongly bactericidal and non-irritating to animal cells. With regard to the employment of electrically decomposed chlorin from sodium chloride solution to sterilize root canals, we shall discuss later.

One may conclude from these statements regarding the direct action of electrolytes in common use that, as used in the experiments cited when *acting alone*, i. e. without electric current, are either (1) *not effective* in *killing bacteria* or (2) are effective (a) only after considerable time or (b) in short periods of time, in concentrations which are not easily used in dental practice. The several electrolytes, the effects of which have been thus studied, are those most used in electrolytic medication or accessible for use. Other electrolytes which may be effective in usable concentrations, i. e. so as not to injure body cells beyond repair, and to kill bacteria in periods of time of two hours or less, have not been studied within the knowledge of the writers. It appears to us, then, that if, with the aid of electrolytic medication, up to the present, certain infections have been checked, infected areas sterilized, or repair instituted as a result of the action of electrolytes or their ions, it is not a direct independent effect of electrolytes upon the bacteria.

Galvanic Current and Living Tissues.

The action of direct current upon bacteria has not been studied carefully to any appreciable extent. Becquerel, Davey, Fabre, Paleprat, Guardana, d' Hahn, Hassenstein, Mangani, Priestly, Sigard and de la Fond investigated the action of galvanic current upon tissues between 1870 and 1875. Cohn and Mendelsohn in 1883 reported some studies of the effects of low galvanic currents on bacteria in nutrient solution, and this work was continued by Prochowink and Spaeth in 1890. Apostoli and Laquerriers in 1890 tried currents of 100-150 milamperes in nutrient medium and reported them efficient in killing bacteria, attributing the results to electrolytic products. Versoogen reached the same conclusion in 1891 after similar experimen-

*loc. cit.

(14) Dakin, H. D., Proceedings Royal Society, England, 1916, B. 89, 234.

tal work. Zierler and Lehmann (Wurzburg) in 1900 gave a detailed account of the action of galvanic current on bacterial infection of root canals. None of the evidence from these investigators is as conclusive in telling us about the action of the current as is that from the researches of Loeb, Maxwell, Jennings, Kühne, Nernst and others working to give a physico-chemical explanation of the phenomena involved. The results of older investigators were conflicting; sometimes indicating that electric current would kill bacteria, at other times it would not. The physico-chemical studies have given us very definite ideas as to how the current acts and have established the fact that it may stimulate, depress, or even cytolyze tissue cells. We now know that the ions move under the influence of the electric current in the living cells much as they do in a battery —going to the opposite faces of the membranes—the physiological "poles" of the cells acting like electrodes. In this manner we would suppose that the ions in the medium surrounding the cells can be accumulated at the membranes. We have thus an effect not unlike polarization in a battery. We now know also that other particles suspended in liquids move with the current. Colloidal particles and even bacteria may be carried in a definite direction by such means (cataphoresis).

In the case of the body with which we are especially concerned, it conducts electricity like a liquid

"in which," as Loeb says, "the current is carried by the dissociated ions or such colloidal particles as possess an electric charge. The concentration of the colloidal particles is very small compared with that of the electrolytes in solution, so that the conduction of the latter one is mainly or practically exclusively responsible." (15)

Two effects are produced by the constant current in living tissue—one following any rapid change in the intensity of the current, the other

"thruout the whole duration of the current and consists in an increase of irritability at the cathode and a decrease at the anode."

The work done by the current in passing thru a liquid conductor

"consists, first, in the pulling of the ions thru the liquid to the electrode and, second, in the withdrawal of the charges from the ions and the transformation of the latter into uncharged atoms at the electrodes."

Loeb and others believe that the latter is unimportant: Köller (16) attempts to make use of the transference of the charge from the ion to the tissue, considering that the charge now given up to the tissue cell (not to the electrode) is the principal factor. On this question there is no evidence known to the writers. It seems from the evidence which is at hand that the physiological actions of electric current are due almost wholly to the increase of the concentrations of ions at the electrodes. Now, it is especially significant that the membranes may serve as electrodes, in many cases where the radicals or ions are precipitated in their uncharged form unlike the action at the poles of a battery where polarization phenomena occur.

Two other effects are recognized in connection with the passage of electric current thru living tissues. One of these is the rise in temperature. In 1898 (17) one of us (Price) considered that the rise in temperature was important and calculated this rise in degrees centigrade, per second. Without considering opposing forces such as radiation, the increase was calculated as 4.04 degrees centigrade per second. This was in the tissue in the apical foramen. The effects of temperature are, of course, im-

(15) Loeb, J., Dynamics of Living Matter, Macmillan, N. Y. 1906, page 98.

(16) Köller, H., Correspondenz-Blatt für Schweiser Aerzte, Basel, April 28, XLVII, No. 17, pp 513-44 and No. 16, p 485.

(17) Items of Interest, May 1898.

portant in living phenomena, heat rigor in muscle beginning at 42 degrees centigrade, and probably some type of coagulation changes taking place in other tissues. The action of heat is reversible up to a certain point but if the temperature is changed suddenly, or maintained for any length of time beyond the normal range, it is irreversible. The temperature to kill *bacteria,* however, is considerably beyond what the body will tolerate, requiring a temperature above 50 degrees centigrade for some time. In some cases, with spores, a temperature of 120 degrees centigrade must be maintained for thirty minutes. No such temperature would ever be reached in the body without destruction of vital cells. In this connection we have found in a series of tests that, if the temperature were maintained constant and below 37.5 degrees, the passage of direct current of 100 volts thru a culture of bacteria for fifteen minutes is of no effect. Without preventing the rise in temperature the same current inhibited the growth in one minute and disinfected it in five minutes. This current is, of course, impossible of attainment with a patient for any length of time, not even an instant.

There is also the effect of very weak currents in living cells. In the case of Actinospherium (a single celled animal used to demonstrate this electrical effect), Kühne reports thus:

"When subjected for some time to constant current it begins to disintegrate on the anode side. This is a purely electrolytic effect, not one which could be considered stimulating."

Phenomena of secretion are also produced by the constant current which, in the case of Amblystoma (a salamander) reported by Loeb was shown to be a direct effect on the gland cells of the body surface.

"When a current is sent thru a trough filled with water which contains an Amblystoma, a secretion of whitish mucus appears on the skin wherever the outside of the latter is struck by the current waves emanating from the anode."

If paramecia (another single celled-form) are subjected to constant current

"the effect is such that the position of the cilia on the side of the cathode is altered while on the side of the anode the cilia retain their normal position, provided the current is not too strong."

This effect is produced mechanically, and chemically as well. Effects of this kind are presumed to occur with bacteria, and like effects probably take place in the body during infection.

We believe from this that there is no evidence to justify the assumption that galvanic current can sterilize infected tissues in the body by killing bacteria directly, without serious destruction of body cells. The current would act as we have seen by precipitating the ions at the bacterial membranes if it would act at all and thus, by changing the electrical and chemical condition, lead to cytolysis. But this same action is going on with the body tissue cells. There appears in the case of the body, as we know, a characteristic regulation and change during the passage of perceptible weak galvanic currents, (such as are used in electrolytic medication). The cells presumably accomodate themselves to the movement of the ions while the current is flowing. They are affected only by a sudden increase or decrease in the intensity of the current (sudden accumulation of ions). As we have found no evidence to the contrary and in our experiments bacteria were not killed during the passage of constant current, we presume the bacteria, likewise, take care of the polarization.

Electro-Chemical Effects.

In possible contrast to the action of electrolytes and constant electric current, independent of each other, we shall now be concerned with their combined (electro-chemical) action. The impression of most of those who use electrolytic medication seems to be (1) that electric current will drive ions into tissues which they could not otherwise penetrate, (2) that the electric current dissociates

("ionizes") the electrolytes in the solution, or the electrode in the tooth (root canal), or both, and (3) that there is an electrolytic action in the tissues. This impression has been favored by experiments of Prinz, Sturridge, Jones, Finzi, and others, in the following way:

Experiments by Finzi (18) are reported by Jones (19) and Sturridge (20) where potassium ferricyanid ions were carried into the tissues of "cats, rabbits, a monkey and a dog," by electric current. Without the current it is reported that the ions had not penetrated. Leduc is reported by Sturridge (21) as having used colored ions and demonstrated that they penetrated into the body. Permanganate of potash ions were employed on both arms where the electrodes were in contact with the flesh. At the positive pole no staining took place while at the opposite pole a brown punctate rash appeared. Sturridge (22) demonstrated the movement of copper and iron ions into coagulated albumen, noting the movement of green (cupric) ions and blue (Turnbull's, not "Prussian" blue,) indicating ferrous ions. Prinz has introduced two experiments to indicate the migration of chlorin. In reality he has demonstrated the movement of the hydrogen ion. In one case a tube of an alkalin gelatine solution, "containing 1% of sodium chlorid, colored pink with phenolphthalein," has a platinum electrode in each end.*

With the passage of an electric current hydrogen ions migrate from the anode toward the cathode and hence make the solution in the region of the anode colorless. This change of color is due to the transformation of the phenolphthalein. In alkalin solutions a sodium salt of phenolphthalein is formed which dissociates into the cation sodium and a colored complex organic anion. The presence of hydrogen ions forms undissociated (colorless) molecules, a quantity of which leads thus to the change of the color of solution. (This cannot be attributed to chlorin). In a similar experiment Prinz has the anode passing thru the foramen of a tooth. As before, the change of color is due to the migration of the hydrogen ions, from the anode. Jones, further, in an experiment, has demonstrated that ions will penetrate bibulous paper to a considerable depth.

The experiments cited are unsatisfactory because (a) definite concentrations of reagents are not reported, (b) the destruction of body tissue cells and the disinfection of bacteria are not taken into account, and (c) the conclusions do not apply directly to the conditions as met with in electrolytic medication. In other words, these experiments do not demonstrate that the ions employed are toxic to bacteria in the concentrations used nor that they will sterilize infected tooth or periapical tissue—the objectives of electrolytic medication. Hence, we believe that it is essential to consider the electro-chemical effects from a different angle than heretofore.

It is surprising that, in discussions regarding electro-chemical actions accompanying electrolytic medication, the structure and functions of the body tissues and their role as physical and chemical forces have been overlooked. This has led to many misconceptions. For example, the results of Finzi and others have been taken to indicate that ions would penetrate to the periapical tissues from the pulp chamber and root canal with a direct current flowing. We have found that this is not wholly true

(18) Finzi, N. S., Brit. Med. Journal, November 2, 1912.

(19) Jones, H. Lewis, "Ionic Medication," 1914, 2d Ed.

(20) Sturridge, E., "Dental Electro Therapeutics," 1914, 216.

(21) Sturridge, E., Loc. Cit. p 218.

(22) Sturridge, Royal Soc. Med. Odontological Section, 1912, and loc. cit. 214, Vol. 5, p 102.

*This is an adaptation of Sir Oliver Lodge's experiment to show the velocity of the migration of ions.

for some ions will not penetrate the tooth wall and their conduction thru the periapical foramen is liable to be altered by the ebullition of gas. The migration velocity of the ions in use appears on calculation to be so slow that it is doubtful if the ions in the solution in the pulp chamber actually reach the periapical tissues. A further consideration of the results of some investigators has led us to presume that the reported effects of electrolytic medication must be referred to something other than the ions contained in the solution, which is placed in the pulp chamber, or the electrode in use.

It will be necessary, to make this clear, to discuss the questions in the following way. So far as the physical effect of the electric current upon the ions, in a liquid, is concerned it is to increase the diffusion in a certain direction. One result of the passage of the current is thus to increase intensity of the ions at certain points in a mean path. The electric current thus directs the ions, those ions moving to the anode are called anions, those to the cathode cations, after the original nomenclature of Faraday. The electricity cannot flow thru a liquid conductor unless there are ions to conduct it.

It will be of value here to review the development of this conception. The determinations of osmotic pressure by Pfeffer, De Vries, Van t' Hoff and Arrhenius indicated that there were two classes of substances, one group which conformed to a theoretical conception of the chemicals, and another group which were extreme exceptions to this formulation. The former group includes the sugars, the latter, acids, bases and salts. It was observed that the latter group in water solutions conducted electricity while the former did not, and thus it appeared that there must be some connection with the acids, bases and salts and the galvanic stream. The acids, bases and salts, it was also noticed, did not conduct electric current in other solvents to any marked degree. In water it was found that HC1 exerted twice the effect upon the freezing point (a physical test of osmotic pressure) that it would have if it acted as a gas and thus it seemed as tho it must be split up into two parts, H and C1. But hydrogen and chlorin were known to exist when gases as H_2 and $C1_2$. It was at first difficult to understand what happened to the HC1 in the solution. It had been observed that the passage of electric current thru a liquid is accompanied by the transference of matter, for example, the ions, to which we have referred. It is associated also with either the solution of the metal of the metallic electrodes or the separation of the substance in the solution and its deposition on the electrode. Dry HC1 gas does not conduct electricity. There is no conduction with very pure water between the poles, say, of a battery. The current, however, does pass freely when the HC1 is dissolved in the water. Now free chlorin separates at the anode where the current enters the solution and free hydrogen at the cathode where the current leaves the solution. One component, then, wanders in one direction, the other in the other direction. Faraday called these wandering particles "ions." The passage of positive electricity into the solution at the anode is associated with the separations of anions and the passage of the positive electricity out of the solution into the cathode is associated with a separation of cations. The term dissociation had been early applied to the separation or cleavage of larger into smaller molecules, or molecules of one into molecules of a different species and was utilized here, the phenomenon being termed "electrolytic dissociation." Some have spoken of it as "ionization" but this term is reserved by a growing group of scientists to apply to the formation of ions in gases produced by the action of Röntgen rays and the like. From

experiments, it is known that molecules do not always split up into the ions in the same way, nor do all of the molecules entirely split up. Some portions of the bodies remain in the solution as undecomposed molecules which are electrically neutral and do not, then, conduct electricity. H_2SO_4, for instance, splits up into $H+$, and $HSO_4—$,or in more dilute solutions into $2H+$ and $SO_4—$.

If, now, in a water solution of HCl we place two platinum electrodes and connect these with a source of galvanic current one plate, connected with the positive pole of the battery, is charged positively and the other, negatively. The free electricities of the electrodes act upon the free ions which are charged with free electricity attracting the positive ion by the negative electricity of the cathode to the negative pole, and the negatively charged ion to the anode, the positive pole. No such force will be exerted upon the neutral molecules. The same quantity of electric current sets free chemically equivalent quantities of the most various ions from the most various solutions. This is Faraday's law. This law, of course, applies to the quantity of each ion which is deposited as neutral molecules at the electrodes and not as Prinz (23) would have us understand to the production of ions in the solution. Electrolytic dissociation and the deposition of ions at the electrodes with the passage of electricity is one thing; the production of ions by the cleavage of a salt, acid or base, in the solution apart from, and independent of, the passage of electric current is distinctly another. Confusion here makes a tremendous difference in one's conception of electrical and ionic action. The ions, then, do not depend upon the current but the current depends upon the ions (24).

Since Sturridge (25) suggests that one can "dissociate a particular ion" at the anode and send it into the tissue by the aid of the current, we may consider this point. This author states that the zinc ion will dissociate from the chlorin ion at the anode. In his text he specifies a zinc electrode in a zinc chloride solution. Apparently he neglects the zinc ion dissociated from the zinc chloride and proceeds to speak of the therapeutic value of the zinc ion from the electrode. If the electrolytic dissociation theory is true there are zinc ions thruout the solution wherever the zinc chlorid is dissolved. A zinc electrode placed in this zinc chlorid solution throws off a few ions—before the current is turned on—and then no more of the metal ions go into solution. A balance exists—or as we speak of it physically, there is "equilibrium." No more zinc ions, beyond these few, will go into solution even if the solution be pure acid or there be acid in the zinc chloride solution. But if in the solution a platinum strip be placed and connected with the zinc strip, the equilibrium is disturbed. More zinc ions go into solution. With acid present hydrogen ions from the acid give up their charge to the platinum and escape as gas. The platinum now becomes positive with respect to the zinc and a positive charge flows from it to the zinc. The zinc having received positive electricity can begin dissolving anew and continue to pass into solution as long as it receives positive electricity from the platinum, that is, as long as there are any hydrogen ions in the solution to furnish positive electricity to the platinum. The passage of an electric current as from a battery thru a zinc chlorid solution with a zinc electrode as anode, and, let us suppose, a platinum electrode as cathode results in a similar transformation. As fast as the zinc ions are separated out of the solution at the cathode zinc would dissolve at the anode, the metal electrode throwing off cations. Even in a sodium chloride solution this

(23) Prinz, Loc. cit., p 379.

(24) Adapted from Nernst, 6th Edition, "Theoretical Chem." p 356.

(25) Loc. cit. p 245.

would result. For as fast as the cations (sodium in this case) in the vicinity of the cathode are precipitated upon the electrode the zinc electrode would dissolve, sending into solution just as many ions as are separated at the cathode.

Since Prinz doubted the presence of zinc in a sodium chloride solution under the above conditions, and there is no theoretical explanation why they should not be present, we experimented as follows: A zinc and copper electrode were immersed in a beaker with twenty-five cubic centimeters of a one per cent sodium chloride solution,* and a current of five milliamperes was passed thru the solution in the direction of zinc to copper. One cubic centimeter samples were removed every fifteen minutes for two hours. One cubic centimeter of an ammonium sulfide test solution was added to the portion. In one hour traces of zinc were visible and the precipitate was increased noticeably in the samples taken after a longer time of action. (Tests of the sensitivity of this particular reagent indicated that one part of zinc in 20,500 parts of solution could be detected). This appears to verify the statement that zinc ions exist and indicates that they can be detected in a sodium chloride solution after the passage of an electric current of 5 ma, if sufficient time is allowed. Six minutes allowed by Prinz (26) was too short a time for enough zinc to dissolve from the anode so that it could be detected by the reagent. As will be seen in our tests, it required one hour for more than one part of zinc in 20,000 parts of solution to be present.

It will be of interest here to discuss the migration velocities of the ions, since in electrolytic medication it is presumed that the ions (the supposed disinfecting agents) will travel from the root canal to the periapical tissues during the time of medication. Now hydrogen, the fastest moving ion, penetrates a gelatine solution (where water is in the usual physical sense the "continuous" phase) to a depth of 0.18 cm, or 0.02 of an inch per minute with a gradient of one volt. Other ions move from five to ten times as slowly or one-fifth to one-tenth as fast. Zinc would penetrate under the same conditions a little faster than 0.003 of an inch per minute. If a metallic ion traveling as fast as zinc actually diffused thru the tooth structure or the apical foramen, the amount in fifteen minutes at this rate would be small; but as we shall see presently the physical conditions of the tooth are not the same as in a gelatine or water solution.

We have, thus far, in dealing with the electro-chemical phenomena, considered the condition as similar to a battery, that is, two electrodes separated only by a liquid. We must now observe what conditions obtain where the electrodes are separated by liquids either side of a semi-permeable membrane a porous partition like the tooth wall, by a capillary like the root canal, and by body tissues

We began our experimental work upon this question by assuming that the devitalized tooth was a porous partition not unlike a clay wall. We reasoned that if this were true we could determine approximately the flow of cations or anions thru the pores in unit time, and, by calculating from the amount of disinfecting ions necessary to sterilize a definite quantity of infected tissue, we could determine the time necessary to disinfect under more or less definite electrical and chemical conditions. But not only did we find that the ions we used would not kill bacteria, we found that the cation zinc and the anion iodide (two supposedly reliable disinfecting agents) would not penetrate the porous partitions we used. Copper we found would penetrate where zinc would not. It made no difference what concentrations or what quantity of solution we used, similar results were obtained.

Our experimental cells were as fol-

*Prinz, loc. cit.

(26) Prinz, loc. cit. p 381.

lows: (a) "porous cup" of a battery: (b) Berkfield (clay) and Alundum filters; (c) porcelain tubes of the average volume capacity of a tooth; (d) freshly drawn teeth with apex sealed. The "set up" may be illustrated as follows:

Zn	$ZnSO_4$	Membrane or Partition	NaCl	Pt

SCHEMATIC ARRANGEMENT.

EXPERIMENTAL DIFFUSION CELLS

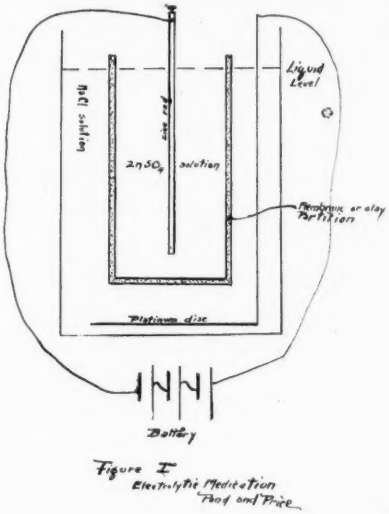

Figure I
Electrolytic Medication
Pond and Price

The solutions in the inner and outer chambers were always adjusted to the same level and were made up of equal osmotic pressures. The quantities were reduced to very small volumes in some cases and relatively large in others. For example, the teeth and small porcelain tubes would hold 0.1 to 0.5 c. c. and were immersed in 0.5 c. c. to 1 c. c.; the filters held 2 c. c. and were immersed in 10 c. c.; the porous cups holding 25 c. c. were in 30 c. c. of solution. The apparatus available was not ideal but the best at hand. The osmotic pressure which the porous partitions would sustain, and the total cross sectional area of the pores, could not be determined with means and time at hand. In every case a constant current was passed thru the cells for nearly three hours. The current used varied from 0.2 ma to 5 ma and the potential was from 2.4 volts in some cases to 28.5 volts in others. 0.5 c. c. samples of the sodium chloride solution were removed at intervals of five minutes up to thirty minutes and every 15 minutes thereafter. To this was added an equal quantity of one of three reagents of known sensitivity, viz. normal* Na_2CO_3, normal potassium ferrocyanide, and an ammonium sulfide solution prepared by saturating 300 c. c. 6-N NH_4OH with H_2S, adding 200 c. c. 6-N NH_4OH and diluting to a liter. In spite of careful tests where the reagent was sensitive to as little as 1:300,000, no zinc was detected after the current had past for more than two hours. With copper the tests with the potassium ferrocyanide indicated its presence after fifteen minutes. Potassium iodide could not be detected with soluble starch solution— (0.5 gm in 25 c. c. of boiling water) under similar conditions to those with zinc and copper. These experiments indicated to us that the tooth and clay or porcelain wall was impermeable to the zinc and iodide ions, but not to copper. Other investigators have reported similar results (27).

An explanation of these results involves a consideration of the size of the pores, the size of the ions, the speed of migration, the electrical condition of the porous partition and the chemical condition of the ions. It has been found that the tooth wall bears a negative electric charge to water like clay and porce-

*"Normal"—chemical equivalent weight in liter of solution.

(27) McClendon—"Physical Chem. of Vital Phenomena," 1917, pp 104-08.

lain. This would account for the opposition to the anion iodide under some conditions. In experiments where Al Cl_3 was added, the charge was reversed and the iodide was found to penetrate, demonstrating that this is presumably correct. Zinc ions would not reverse the charge of the partition. With zinc sulfate in the anode chamber in the case of large pored partitions, it is conceivable that the positively charged zinc ions are attracted to the partition and held there, forming a positive layer, blocking the passage of any more cations thru the pores. The bulk of the current would be, in such cases, conducted by the anions. In the tooth the pores are infinitely smaller and the anions would be repelled by the negative charge of the wall. As the current flowed thru the wall and no zinc ions were detected chemically as having passed thru (verified also electrometrically), we assume that the current was carried mainly by hydrogen and chlorin ions. It is possible that hydration of the zinc ions occurred and hence the ions so enlarged were not able to penetrate the pores. Copper supposedly is not enlarged and thus may penetrate readily. These questions must be further investigated.

To determine whether the ions had free access thru the apical foramen and what factors were involved in the conduction of the current from the pulp chamber to the surrounding tissues, particularly the proportion of current passing thru the apical foramen to that thru the lateral walls to the peridental membrane, we have made the following experiments.

In the literature on ionic medication the authors seem to have taken for granted that the current was being delivered to the tissues involved. This problem of current path had previously been studied by one of us, (Price, Items of Interest, May 1898) in connection with cataphoresis.

In tables III and IV we have determined the influence of the position of the electrode on the conductivity thru each the apex and lateral walls, and the ratio of the current carried thru the apical foramen when the electrode is within one-eighth of an inch of the apex, to the current carried by that same column of normal salt solution when the electrode is placed in the pulp chamber, usually producing a column about one-half an inch, or a little less, in length. In these series we have also studied the influence the various positions of the electrode have had upon the current conductivity thru the lateral walls of the tooth when the apex was sealed. These observations demonstrate that the position of the electrode has a great deal to do with the quantity of current that can be carried thru each the root apex foramen and the root walls. In the former if the electrode is placed just to the exit of the foramen, tho not beyond, the ratio of current to that carried when it is within the pulp chamber ranges from two to one to eighty-six to one, with an average ratio of twenty-six to one. This demonstrates the importance of extending the electrode to the apex. The influence of these variations of position of the electrode upon the conductivity thru the root walls is not nearly so great, averaging only as two is to one. This emphasizes the necessity that the electrode extend to the apex. The results of the series also indicate the actual current conductivity thru each the apical foramen and the lateral walls and express them relatively to each other; the actual carrying capacity of the lateral walls as compared with the foramen, using for the ratios the position of the electrode one-eighth inch from the apex. It is much the greater, varying from equal to sixteen to one in the extreme, with an average in the series of three to one. Since the pathological condition is presumed to be directly related to the foramen and quite limited to that area of the tooth, in such cases as would be considered favorable for this method of treatment,

we must conclude that with the electrode placed to about one-eighth of an inch from the apex, only one-fourth of the total current could be passing thru the pathological tissue, and the other three-fourths would probably be penetrating normal tissues. In this series we have

In Table V we have determined the difference in the conductivities, whether a platinum electrode is used or a zinc electrode, and also the amount of current carried thru each the apical foramen, the apical half of the root wall and the gingival half of the root wall, as well as to-

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
INFLUENCE OF THE POSITION OF THE ELECTRODE ON THE CONDUCTIVITY THROUGH EACH THE APEX & LATERAL WALLS

TABLE III

Electrolyte - Normal Salt Solution

Serial No.	Tooth	No. of Roots	Approx. size of Foramen	Conductivity and Resistance through apex only. From Platinum Electrode Placed In Pulp Chamber	1/4inch from apex	1/8 inch from apex	In Apex	Ratio of Electrode in apex to Electrode in Pulp Chamber	Conductivity & Resistance through lateral walls only Tip Sealed. From Platinum Elect Placed In Pulp Chamber	1/4 inch from apex	1/8 inch from apex	Ratio of Electrode sealed in apex to Electrode sealed in Pulp Chamber
	Upper			0.1	0.13	0.16	3.9		0.5	0.8	0.95	
1	Latrl	1	.008	55000	42308	34375	1410	4:1	11000	6875	5789	2:1
				.05	.05	.11	4.3		0.27	0.35	0.35	
2	Cuspi	1	.0065	110000	110000	50000	1279	86:1	20370	15714	15714	1:1
	Cntrl			.08	.12	.22	5.0		0.29	0.29	0.3	
3	Incis	1	.0096	68750	45933	25000	1100	62:1	18966	18966	18333	2:1
	Upper			.07	.09	.11	3.8		0.35	0.35	0.34	
4	Latrl	1	.0085	78571	61111	50000	1447	54:1	15714	15714	16176	5:1
	Upper			.11	.13	.21	3.0		0.19	0.205	0.35	
5	Bicus	1	.0085	50000	42308	26190	1833	27:1	28947	26829	15714	7:1
	Lower			.09	.1	.11	3.75		0.2	0.8	0.2	
6	Incis	1	.008	61500	75000	68100	2000	42:1	27500	12500	27500	1:1
	Lower			.1	.11	.19	5.0		0.38	0.35	0.69	
7	Bicus	1	.0075	75000	68100	39800	1800	50:1	19700	21400	10800	4:1
				.49	.55	.61	.71		1.13	1.45	1.6	
8	Cuspi	1	.0075	11020	9810	8850	7800	1½:1	4770	3720	3600	1:1
				.19	.19	.19	2.2		0.69	0.66	0.9	
9	"	1	"	28420	28428	28420	2520	11:1	7820	6270	6000	1:1
				.11	.14	.28	1.9		.18-.2	.28	.29-.35	
10	Latrl	1	.0065	68100	40000	28200	3360	17:1	37350	22800	10100	2:1
				.35	0.4	.52	0.8		.48	.36	.34	
11	"	1	"	18200	18000	12300	8000	2:1	13300	17700	18800	1:1½
	Upper			.2	.25	.31			1.08	1.15	1.35	
12	Latrl	1	.008	30000	24000	18350			5680	5217	4444	1:1
				.24	.24	.27			.48	.51	0.5	
13	Cuspi	1	.0065	25000	25000	22222			12500	11764	12000	1:1
	Centr			.45	.49	.57			.66	.71	.79	
14	Incis	1	.0095	13333	12240	10620			8820	8450	7595	1:1
				.2	.21	.22	.33		.74	0.9	0.96	
15	Cuspi	1	.0075	30000	28570	27270	18180	1½:1	8108	6666	6250	2/3:1
				.27	.29	.32	1.06		0.41	0.51	0.55	
16	"	1	"	22222	20687	18750	5714	4:1	14630	11764	10909	1:1
				.5	.55	.62	5.0		.88	.97	1.1	
17	Latrl	1	.0085	12000	10909	7317	1200	10:1	6818	6185	5464	1:1
				.53	.59	1.02	1.3		.57	.75	.81	
18	"	1	"	11320	8690	5882	4615	2½:1	10520	8000	7407	1:1

Average 26:1 Average 2:1

reduced the conductivities thru the various paths to ohms resistance, as well as expressing them in milliamperes carrying capacity. We have also determined the ratio of the conductivity thru the gingival half of the root wall to the apical half, not including the foramen. These show a wide variation but in the majority of cases the conductivity is greater thru the gingival half of the root walls than the apical half.

tals. The rate of generation of gas is a little greater with platinum than with zinc in a sodium chlorid solution, the gas being different and the conductivity is, accordingly, generally greater with the zinc electrode than with the platinum. While this series shows a wide variation in the ratio of conductivity thru the lateral walls of the root to that of the apical foramen, the average for this series is as four is to one. In other

words, one-fifth of the total current flowing would, on the average, be passing thru the foramen to the pathological tissue and four-fifths to the healthy peridental membrane thru the lateral walls.

In Table VI we have studied the conductivities thru apices and lateral walls .004″ to .0065″, or entirely blocked in Nos. 37 and 46. It is interesting to note that, while the apex of No. 38 was blocked against the wire used, the conductivity indicates that the foramen is at least medium in size and the shape of the canal undoubtedly prevents passing

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
INFLUENCE OF THE POSITION OF THE ELECTRODE ON THE CONDUCTIVITY THROUGH EACH THE APEX & LATERAL WALLS
TABLE IV

Serial No.	Tooth	No. of Roots	Approxi. size of Foramen	Conductivity & Resistance through both apex & walls From Platinum Electrode Placed			Ratio of Electrode 1/8" from apex to Electrode in Pulp Chamber	Conduct.& Resist. through lateral root walls-Plati. sealed to apex		Ratio of Gingival Half of Wall to Apical Half	Ratio of Conductivity of Wall to Apex
				In Pulp Chamber	1/4 inch from apex	1/8 inch from apex		In Total	Apical Half		
1	Upper Latrl	1	.008	1.05 5238	1.18 4661	1.2 4583	1:1	1.2 4583	0.71 7747	1:1	7:1
2	Cuspi	1	.0065	0.26 21154	0.4 13750	0.4 13750	1:1	0.3 18333	0.05 110000	5:1	5:1
3	Cntrl Incis	1	.0095	0.27 20370	0.35 15714	0.4 13750	1:1	0.65 8462	0.49 11224	1:3	3:1
4	Upper latrl	1	.0065	0.6 10784	0.5 11000	0.6 9166	1:1	1.75 3143	0.8 6875	1:1	16:1
5	Upper Bicus	1	.0065	.28 19600	0.3 18333	.37 14800	1:1	1.3 4230	0.95 5789	1:3	6:1
6	Lower Incis	1	.008	.68 11000	0.2 37500	1.23 32600	7:1	0.23 32600	0.18 41600	1:4	2:1
7	Lower Bicus	1	.0075	.41 18200	0.5 16000	0.7 10700	2:1	1.0-1.5 6250	0.15 80000	7:1	7:1
8	Cuspi	1	.0075	1.14 4730	1.5 3600	1.68 3210	1:1	1.15 4690	0.6 9000	1:1	2:1 Zn
9	"	1	"	0.69 7820	0.93 5800	1.0 5400	1:1	.82 6580	.42 12850	1:1	4:1 Pt
10	Latrl	1	.0095	.31 20640	.39 16410	.44 14540	1:1	.35 18200	0.1 64000	3:1	1:1 Pt
11	"	1	"	.66 9690	2.0 6400	1.1 5810	2:1	0.3 21330	0.12 53300	1:1	1:2 Zn
12	Upper Latrl	1	.008	1.15 5217	1.4 4285	1.68 3570	1:1	0.99 6080	0.65 9230	1:2	3:1
13	Cuspi		.0065	0.48 12500	0.53 11320	0.55 10909	1:1	0.4 15000	0.15 40000	2:1	2:1
14	Cntrl Incis		.0095	0.70 8571	0.76 8000	0.8 7500	1:1	0.62 9677	0.35 17142	1:1	1:1
15	Cuspi	1	.0075	0.81 7407	1.0 6000	1.0 6000	1:1	0.55 10909	0.23 26087	1:1	2:1
16	"	1	"	0.42 14285	.54 11111	0.59 10169	1:1	0.55 10909	0.48 12500	1:7	1:1
17	Latrl	1	.0085	1.7 3529	1.9 3157	2.1 2857	1:1	1.0 6000	0.78 7692	1:4	1:1
18	"	1	"	0.65 9230	1.2 5000	1.4 4285	2:1	0.92 6521	0.7 8571	1:3	1:1
				Average 1½:1						1:1	3:6

when the foramen is very small or apparently blocked. These have shown a very high resistance thru the apex. It will be noted that in the fourth column of each of these charts we have recorded the approximate size of the main apical foramen. We could conveniently measure only one, namely, the one nearest in alignment with the pulp canal. In this series (Table VI) the apices were from an instrument thru it. This series demonstrates that when the foramen is small it is a matter of wide variability as to what the ratio of conductivity of the wall will be to the apex. The same conditions that produce the closing of the foramen probably cause an increase in the density, therefore the lowering of the conductivity of the lateral walls of the tooth as well. There is also a very wide

variation in the conductivity of the gingival half to the apical half. No. 21, (Table V) for example, had a foramen .005″ in diameter and the tooth had extensive excementosis. The walls of the tooth were so poor a conductor that practically no current was carried and amina and their ratios to other paths. In this class of tooth we have included foramina ranging from .0055 to .0010 of an inch in diameter. We have placed the electrode, in this case zinc, as far into the canal as possible and in no case did it penetrate the apex, distant from about

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
COMPARISON OF ZINC & PLATINUM AS ELECTRODES AND OF CONDUCTIVITY & RESISTANCE OF DIFFERENT CURRENT PATHS
TABLE V

Serial No.	Tooth	No. of Roots	Approxi. Size of Foramen	Pt. Electd. 1/8 inch from apex	Zinc Electd. 1/8 inch from apex	Apex Only	Apex and One-Half Wall	Apex and Total Wall	½ Wall Only Apex Sealed	Total Wall Apex Sealed	Ratio of Wall to Apex
	Cntrl					0.1	0.11	0.3	.04	.14	
11	Incsr	1	.0094	#		64000	58180	21330	160000	45700	1½:1
"	"	"	"		#	0.5	0.5	.96	.25	.68	
						12800	12800	6660	25600	9410	11/3:1
	Lower						.09	.25	.15	0.49	
12	Incsr	1	.0063		#		71110	25600	42660	13060	
"	"	"	"	#		.04	0.16	.39	0.1	0.33	
						160000	40000	16410	64000	19390	8:1
	Lower					.66	.65	.65	0.1	.38	
13	3Molr	2Canal	.0139		#	9690	9840	9840	64000	16800	1:1 2/3
"	"		"	#		.3	0.4	0.41	.11	.15	
						21330	16000	15600	58180	42660	1:2
	Upper		Apex				.09	.29			
14	Bicus	1	closed		#		71110	22060			
"	"	"		#		.1	.16	0.2			
						64000	40000	32000			
	Lower					.08	.11	.68	.3	.72	
15	Incsr	1	.005		#	80000	58180	9410	21330	8800	9:1
"	"	"	"	#		.01	.13	.68	.24	.51	
						640000	49230	9410	26660	12540	51:1
	Upper					.24	.28	.35	.11	.16	
16	Cuspid	1	.005		#	26660	22850	18280	58180	40000	1:1 1/2
"	"	"	"	#		.04	.13	.16	.11	.138	
						160000	49230	40000	58180	46370	3½:1
	Lower					.28	.3	.9	.8	.85	
17	Cuspid	1	.0076		#	22850	21330	71110	10666	7620	3:1
"	"	"	"	#		.27	.5	.65	.15	.55	
						23700	12800	9840	42660	11630	2:1
	Lower					.13	.11	.12	.1	.12	
18	Incsr	1	.0076		#	49230	58180	53330	64000	53330	1:1
"	"	"	"	#		.1	.1	.1	.1	.1	
						64000	64000	64000	64000	64000	1:1
	Lower					.29	.29	.3	.08	.14	
19	Bicus	1	.0079		#	22060	22060	21330	80000	45700	1:2
"	"	"	"	#		.15	.15	.18	.08	.09	
						42660	42660	35550	80000	71110	1:1 2/3
	Upper					.55	.66	.71	.63	.76	
20	Lat.I.	"	.0095		#	11630	9680	9010	10160	8421	1½:1
"	"	"	"	#		.4	.44	.51	.37	.46	
						16000	14540	12540	17290	13910	1:1
										Average	4:1

only a very small amount thru the apex. Excementosis greatly reduces the conductivity thru the root wall and, since it is apparently in many cases the result of a local irritation in the form of an infection, we are not able to reach that infection by this means, even if it were competent to destroy the organisms.

In Table VII we have studied the conductivity of medium sized apical foramina ranging from one sixteenth to three-sixteenths of an inch. Two baths were tested, namely, sodium chlorid and mercury. It will be noted that the conductivity of the root wall is very much greater in the teeth in Table VII than in Table VI, which emphasizes the point mentioned relative to the teeth with small foramina, having also an increased resistance to the current in the root wall. Generally, the

conductivity thru the wall is greater than thru the apical foramen. In this series the ratio of the gingival half to the apical half of the root has considerable variation, the chances to passing current streams being about equal.

With Table VIII we have studied the conductivity of large apical foramina and their ratios to other paths. This has included those between .008″ and .009″. These naturally show a marked increase in the amount of current passing thru the apex and also a marked increase in the conductivity of the lateral walls. The ratio of the conductivity laterally thru the walls of the tooth to that passing thru the apical foramen varies in quite a wide range, yet the average for the series shows twice as much going thru the foramen as laterally thru the walls. The ratio of the gingival half of the root wall to the apical half is as two is to one.

In Table IX we have made a comparison of the conductivity of different roots of multi rooted teeth. The foramina ranged in size from no opening to .011″ diameter, the latter being a child's tooth in which the conductivities were large and their ratios between apex and lateral walls, which vary from one to one to one to ten. There is a greater variation, however, than in any other series between the ratios of the gingival thru each the apex and the lateral walls. No teeth were used that were extreme. The ratios of conductivity show a very wide range, suggesting that it is exceedingly problematical in each and every case in the mouth which, of different roots, is carrying the most current, and what their ratios will be. The same is true of the ratios between apex

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
THE CONDUCTIVITY OF SMALL SIZE APICAL FORAMINA AND THEIR RATIO TO OTHER PATHS
TABLE VI
Each Mercury and Normal Salt used for External Bath.

Classifications					Conductivity								Ratios	
Serial Number	Tooth	Remarks	Approximate size of Foramen (Inches)	Kind of Electrode and distance from Apex	Hg Bath	MgCl Bath	Apex Only	Apex and Half of Root Wall	Apical Half of Root	Apex and Total of Root Wall	Gingival Half of Root Wall	Total of Root Wall	Ratio of Wall to Apex	Ratio of Gingival Half to Apical Half
21	Upper Bicus	Excement osis	.006	Zn 1/8	#		.1	.1						
22	Upper Latrl		.0055	" 1/8	#	#	.07 .07	.1 .12	.03 .05	.11 .15	.01 .03	.04 .08	1:2 1:1	1:3 1:2
23	Lower Bicus		.004	" 3/16	#	#	.08 .08	.1 .16	.02 .06	.18 .2	.08 .04	.1 .12	1:1 1½:1	4:1 1:2
24	Upper Latrl		.005	" 1/8	#	#	.09 .08	1.8 0.12	0.7 .03	1.7 .15	.1 .04	1.81 .07	6½:1 1:1	1:1 7:1
25	Lower Incis		.004	" 1/4	#	#	.01 .05	.02 .06	.01 .01	.09 .1	.07 .04	.08 .05	8:1 1:1	7:1 4½1
26	Lower Latrl	Very Small	.0055	" 1/4	#	#	.03 .03	.04 .04	.01 .01	.08 .05	.01 .01	.02 .02	1:1 1:1	1:1 1:1
37	Cuspi	Apex Blocked		" 1/8	#	#	.46 .4	.55 .68	.09 .28	.77 .95	.22 .27	.31 .55	1:1½ 1:1	2½:1 1:1
46	Upper Molar	Canals Blocked			#	#	.09 .05	.19 .44	.10 .39	.4 .48	.21 .02	.31 .41	4:1 8:1	2:1 1:18
47	Lower Incis		.0065	" 3/8	#	#	.05 .09	.05 .11	.00 .02	.18 .24	.11 .13	.11 .15	2:1 2:1	6:1
49	Upper Latrl		.0065	" 1/2	#	#	.09 .1	.12 .1	.03	.12 .1	0 0	.01 0	1:9	

half and the apical half, they being as high as one to eighteen. The ratios between the different roots range from five to one to ten to one. When an electrode is passed thru the apex into a fluid beyond the root, the conductivity is enormously increased, both because of the distance within the apex. We have also determined the ratios to the root walls under these conditions. Owing to the very greatly reduced resistance of the circuit, when the electrode was passed thru the apex, it was necessary to reduce our voltage to 0.1. The figures in Table

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
THE CONDUCTIVITY OF MEDIUM SIZE APICAL FORAMINA AND THEIR RATIOS TO OTHER PATHS
TABLE VII
Each Mercury and Normal Salt used for external bath.

Classifications					Conductivities								Ratios	
Serial Number	Tooth	Remarks	Approximate size of Foramen (Inches)	Kind of Electrode and distance from apex	Hg Bath	$Hg.Cl$ Bath	Apex Only	Apex and Half of Root Wall	Apical Half of Root	Apex and Total of Root Wall	Gingival Half of Root Wall	Total of Root Wall	Ratio of Wall to Apex	Ratio of Gingival Half to Apical Half
27	Upper Cuspi	Very large	.0055	Zn 3/16	*	#	.5 .8	1.1 1.1	.6 .5	1.65 1.62	.55 .42	1.15 .92	2:1 1½:1	1:1 1:1
28	Lower Cuspi		.008	" 3/16	#	#	.15 .15	.25 .2	.1 .05	.5 .51	.25 .31	.35 .36	2:1 2:1	2½:1 6:1
29	Latrl Incis		.0075	" 3/16	#	#	.24 .24	.5 .48	.26 .24	.68 1.1	.18 .62	.44 .86	2:1 3:1	1:1½ 2½:1
31	Upper Cuspi		.00875	" 1/8	#	#	.24 .22	.34 .37	.1 .15	.4 .59	.06 .22	.16 .37	1:1½ 1:1	1:1½ 1½:1
32	Upper Centr	Very large	.0095	" 1/16	#	#	.3 .32	.54 .5	.24 .18	.93 .82	.39 .42	.63 .6	2:1 2:1	1½:1 2:1
36	Upper Latrl		.0085	" 1/8	#	#	.27 .1	.3 .11	.03 .01	.31 .12	.01 .01	.04 .02	1:7 1:9	1:8 1:1
38	Upper Cuspi		.0065	" 3/16	#	#	.37 .33	.61 .54	.24 .21	.87 .87	.06 .03	.30 .24	1:1 1:1	1:4 1:7
41	Cntrl	Large	.010	" 1/16	#	#	.25 1.5	.35 1.7	.10 .20	.9 2.0	.55 .3	.65 .5	3:1 1:3	5:1 1½:1
42	Third Molar	One Root	.0085	¥ 3/16	#	#	.15 .13	1.6 .16	1.45 .03	1.8 .3	.2 .14	1.65 .17	10:1 1:1	1:1 4:1
48	Lower Incis		.007	" 1/2	#	#	.09 .2	.3 .28	.21 .08	.35 .38	.05 .10	.26 .18	3:1 1:1	1:4 1:1
53	Lower Bicus		.0055	" 1/4	#	#	.48 .21	.61 .29	.13 .08	.81 .47	.20 .18	.33 .26	1:2 1:1	2:1 2:1
58	Upper Latrl		.0055	" 3/8	#	#	.38 .4	.78 1.0	.38 .6	1.14 1.66	.38 .66	.76 1.26	2:1 3:1	1:2 1:2

Average 1½:1 , 1:1

elimination of the resistance of each the small column of liquid in the root canal and foramen and of the lateral wall, and is limited only by the voltage and the ability of the gas, formed at the electrode, to escape.

In Table X we have made determinations of the difference in conductivity when a zinc electrode is extended thru the apex, for from 1/16 to 1/8 of an inch to the same when placed about that

X, therefore, cannot be compared directly with those in the previous charts where voltages ranging from 5.5 to 6.6 were used. This will, however, not disturb the ratios. It will immediately be noted that the ratio of the conductivity thru the lateral walls to that thru the apical foramen has been reversed from the condition shown in previous charts, the average being 5.5 to 1, whereas the ratio of conductivities, when the electrode

was withdrawn to 1/8 of an inch within the apical foramen to that of the root walls, averages one to one, even with so large an apical foramen. The most significant factor is the ratio of the conductivity with the electrode 1/16 to 1/8 of an inch beyond the apical foramen to 1/16 to 1/8 of an inch within, the average for which is twelve to one. This very strongly emphasizes the necessity for placing the electrode, if possible, not only to the apical foramen but thru and beyond it if the effects to be produced are to be delivered to the periapical tissues. This condition, however, is difficult with a zinc electrode where the foramen does not exceed in size .008" to .010" of an inch. Such a foramen will be found in the teeth of young people or produced artificially by enlarging. We must not, however, consider, that our difficulties are eliminated by passing the electrode beyond the apex, for in so doing the gas cannot readily be eliminated as it does automatically from the pulp canal. This will be discussed presently.

Another condition that must not be overlooked is that of the production of heat by the passage of a concentrated current. One of us, Price, (28) has previously estimated the heat generated in the different paths of an electric current passing thru the tooth and periapical structures. It is not probable, however, that a sufficient concentration of current may be used to considerably raise the temperature for any considerable distance from the electrode. If it were

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
THE CONDUCTIVITY OF LARGE SIZE APICAL FORAMINA AND THEIR RATIOS TO OTHER PATHS

TABLE VIII

Each Mercury and Normal Salt used for External Bath.

Classifications					Conductivity								Ratios	
Serial Number	Teeth	Remarks	Approximate size of Foramen (Inches)	Kind of Electrode and distance from apex	Hg. Bath	NaCl Bath	Apex Only	Apex and Half of Root Wall	Apical Half of Root	Apex and Total of Root Wall	Gingival Half of Root Wall	Total of Root Wall	Ratio of Wall to Apex	Ratio of Gingival Half to Apical Half
30	Lower Cuspi	Gas Phenomena	.008	Zn 1/16	#	#	.33 .85	.4 .86	.07 .01	.57 1.0	.17 .14	.24 .15	1:1½ 1:6	2½:1 14:1
33	Upper Cntrl	Medium	.009	" 1/8	#	#	.49 .38	.61 .51	.12 .13	.64 1.3	.03 .79	.15 .92	1:3 2½:1	1:4 6:1
34	Cntrl Incis	Medium	.009	" 1/8	#	#	.82 .84	.81 1.2	.19 .36	1.2 1.7	.39 .5	.58 .86	1:1 1:1	2:1 14:1
35	Upper Bicus		.008	" 1/8	#	#	.55 .90	.64 1.1	.09 .2	.8 1.3	.18 .2	.25 .4	1:2 1:2	2:1 1:1
50	Upper Cntrl		.009	" 3/16	#	#	.35 .54	.36 .4	.01 .06	.45 .55	.1 .21	.09 .15	1:4 1:2	9:1 3:1
51	Upper Cuspi		.009	" 1/8	#	#	.89 .6	1.01 .78	.32 .18	2.2 1.65	1.61 1.05	1.19 .77	2:1 2:1	4:1 4:1
52	Upper Cuspi		.009	" 3/16	#	#	.42 .34	.55 .67	.13 .33	.69 .8	.27 .46	.14 .13	1:2 1:1	1:1 1:3
54	Upper Bicus		.009	" 1/8	#	#	1.02 .95	1.4 1.49	.38 .54	2.2 2.0	.8 .81	1.18 1.06	1:1 1:1	1:2 1:3
55	Upper Smlr		.008	" 3/16	#	#	.85 .58	.7 .74	.05 .06	.79 .8	.09 .06	.14 .12	1:5 1:9	1:1 1:1
56	Uoper Bicus		.008	" 5/16	#	#	.82 .85	.75 .77	.13 .12	.89 .8	.14 .03	.17 .15	1:4 1:4	1:1 1:4
57	Upper Cuspi		.0095	" 1/8	#	#	.88 1.05	1.08 1.2	.20 .15	1.2 1.28	.12 .08	.32 .23	1:3 1:5	1:2 1:2

(28) Price, W. A., Foundation principles of cataphoresis—"Items of Interest."—May, 1898, p. 344-376.

possible the application of heat in this form would be an ideal way to sterilize.

The age of the patient has a very marked influence on the conductivity thru the lateral walls of the tooth, as well as on the size of the apical foramen.

sial canal has been greatly enlarged, it will not be possible to go beyond the apex with a zinc electrode in a large number, if not the majority, of cases. We attach our current to both these electrodes. What is the relative amount of current that will be applied to the peri-

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
A COMPARISON OF THE CONDUCTIVITY OF DIFFERENT ROOTS OF MULTI ROOTED TEETH
TABLE IX
Each Mercury and Normal Salt used for external bath.

Classifications								Conductivities							Ratios		
Serial No.	Tooth	Remarks	No. of Roots	Name of Root	Approxi. size of Foramen	Kind of Electd and distance from apex	Bath	Apex Only	Apex and Half of Root Wall	Apical Half of Root	Apex and Total of Root Wall	Gingival Half of Root Wall	Total of Root Wall	Ratio of Wall to Apex	Ratio of Gingival Half to Apical Half	Ratio of Different Roots
39	Lower Molar		2	Mesial	.006	3/16	Hg	.63	.85	.22	1.35	.5	.72	1:1	1:4	1:1
				Distal	.009	Enl/8	Hg	.34	.75	.41	1.25	.5	.91	3:1	1:1	1:1
40	Upper Molar	Young	3	Palatal	.009	" 1/8	Hg	.35	.4	.05	.43	.03	.08	1:4	1:2	
							N/1	.4	.55	.15	1.5	.95	1.1	3:1	6:1	
"		Blocked	"	Mesial Buccal		" 1/4	Hg	.15	.2	.05	.3	.1	.15	1:1	2:1	
							N/1	.18	.28	.1	.3	.02	.12	1:1	1:6	
"		Slightly Broken	"	Distal Buccal	.0075	" 1/8	Hg	.13	.14	.01	.2	.06	.07	1:2	6:1	2½:1:2
							N/1	.17	.2	.03	.35	.15	.18	1:1	5:1	1:2:2
43	Lower Molar	Child's Tooth	2	Mesial	.008	" 1/8	Hg	1.7	1.8	.10	3.4	1.6	.17	1:10	18:1	
							N/1	3.1	3.7	.60	4.1	.4	1.0	1:3	1:2	
"				Distal	.0115	" 1/8	Hg	1.2	1.4	.20	1.6	.2	.4	1:3	1:1	1½:1
							N/1	1.6	1.7	.20	1.8	.1	.3	1:6	1:2	
44	Lower Molar	Child's Tooth	2	Mesial	.0085	" 1/8	Hg	1.1	1.5	.40	1.5	.0	.4	1:3	0	
							N/1	1.45	1.65	.20	1.78	.13	.33	1:4	1:2	
"		"	"	Distal	.00875	" 1/8	Hg	.2	1.1	.90	1.5	.4	1.3	7:1	1:2	5:1
							N/1	1.52	1.95	.43	2.06	.2	.53	1:3	1:2	1:1
45	Upper Molar	Excement osis	3	Palatal	.00875	" 1/8	Hg	.71	.91	.20	1.08	.17	.37	1:2	1:1	
							N/1	.8	1.04	.24	1.44	.4	.64	1:1	2:1	
"			"	Mesial Buccal	.007	" 1/4	Hg	.7	.87	.17	.9	.03	.2	1:4	1:5	
							N/1	.75	.81	.06	.89	.08	.14	1:6	2:1	
"			"	Distal Buccal	.006	" 1/8	Hg	.33	.52	.19	.68	.16	.35	1:1	1:1	2:2:1
							N/1	.4	.67	.27	.73	.06	.33	1:1	1:4	2:2:1
46	Upper Molar	All Cnls Blocked	3	Palatal	Closed		Hg	.09	.19	.10	.4	.21	.31	4:1	2:1	
							N/1	.05	.44	.39	.46	.02	.41	8:1	1:18	
"		Electd in Plp Cham	"	Mesial	Closed		Hg	.2	.26	.06	.81	.05	.11	1:2	1:1	
							N/1	.27	.45	.18	.58	.13	.31	1:1	1:1	
"				Distal	Closed		Hg	.02	.06	.04	.1	.04	.08	4:1	1:1	1:2:10
							N/1	.08	.36	.28	.52	.16	.44	5:1	1:2	1:5:1
"		All Root					Hg	.09	.2	.11	.24	.04	.15	2:1	1:3	
							N/1	.14	.2	.06	.4	.2	.26	2:1	4:1	

When we apply these facts to the actual and relative conductivities of different paths, as determined by different conditions of apex and the root wall, to our practical problems, we have some of the following conditions to meet. Let us suppose a lower molar has an opening thru the distal root of .008″ to .010″ thru which an electrode is inserted. A second electrode is passed into the mesial root as far as possible. Unless the mesial tissues of each root? Since the distal electrode is passed beyond the foramen we have eliminated the resistance of the small column of fluid and its obstruction with the gas of electrolysis. The ratio of the conductivity of an apical foramen of small size to one of large will be as one to five or ten. (See Charts Tables VI and VIII.) Passing the electrode beyond the apex would increase this conductivity still another ten to fif-

teen fold (See Chart Table X). The ratio of the current passing to the tissues about the apex of the distal root to the tissues about the apex of the mesial root would probably be anywhere from fifty to one to one hundred and fifty to one. The logical procedure is to place the electrode in one root at a time and thru the apical foramen, if possible. (This, however, does not yet provide for the elimination of the gas, which, of necessity, forms about the electrode. We see little evidence that gas is a good form of medicament to be applied in the tissues at the apex of the root, but this may be left an open question for further research.) The conditions that obtain with a three rooted molar with the electrode passed thru the apex of any one root would in general correspond, the current always following the path of least resistance, entirely irrespective of distance or direction. We wish to emphasize this because some exponents of this method have erroneously assumed that the current is projected from the end of the electrode much as a high tension static spray or brush.

THE ELECTRICAL CONDUCTIVITY OF DIFFERENT STRUCTURES AND CHANNELS OF THE TEETH
A COMPARISON OF THE CONDUCTIVITY OF A ZINC ELECTRODE EXTENDED THROUGH THE APICAL FORAMEN ABOUT ONE-EIGHTH INCH TO THE SAME IN EQUAL DISTANCE WITHIN THE APEX. V=.1
TABLE X

Classifications					Conductivities					Ratios		
Serial Number	Tooth	Remarks	Approximate size of Foramen	Postion of Zinc Electrode	Apex Only	Apex and Half of Root Wall	Apical Half of Root Wall	Apex and Total Root Wall	Total Root Wall	Ratio of 1/8 inch beyond apex and Root Wall	Ratio of 1/8 inch inside apex and Root Wall	Ratio of 1/8 inch beyond apex to 1/8" within apex
1	Cntrl Incis	V = .1	.0116	1/8 thru	3.85	4.2	.35	4.5	.65	6:1		
"				1/8 within	.02	.22	.20	.35	.33		1:16	13:1
2	Cntrl Incis		.010	1/16thru	4.1	4.4	.3	4.9	.8	5:1		
"				1/8within	.3	.42	.12	.8	.5		1:2	6:1
3	Upper Bicusp		.0098	1/16 thru	4.3	5.0	.7	5.5	1.2	4:1		
"				1/16 within	.31	.34	.03	.38	.07		4:1	14:1
4	Third Molar	Single Root	.0095	1/16 thru	3.75	4.35	.6	4.55	.8	5:1		
"				1/8 within	.3	.32	.02	.34	.04		7:1	13:1
5	Upper Cuspi		.010	1/16 thru	3.45	3.7	.25	3.8	.35	10:1		
"				1/16 within	.34	.37	.03	.4	.06		6:1	9:1
6	Upper Cntrl		.016	1/16 thru	4.4	5.5	1.1	6.0	1.6	3:1		
"				1/8within	.32	.35	.03	.4	.06		4:1	15:1
										5.5:1		Avg 12:1

(Continued in a later issue.)

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Editorial Department.

THE RELATION OF THE DENTAL PROFESSION TO THE GOVERNMENT.

By a few men in the profession the full significance of the legislation at Washington last October was realized, but by only a few. When Congress passed a law granting to Dentistry equal status with Medicine in the Army, a most momentous thing happened affecting the future welfare of the profession. It seems so difficult to get the rank and file of dentistry to comprehend just what this thing involves. Most of the com-

ment on this legislation has been in the nature of congratulating ourselves on the recognition which thereby came to Dentistry, but this is far from being the really significant thing in the situation. It is true that Dentistry may well be congratulated on the recognition thus given it, but attention should be directed less to the honor which has come to the profession and more to the responsibility which it involves. Never before has so much been accorded to Dentistry, and never before has so much been demanded of it; and it is this latter fact which seems to entirely escape the attention of many in the profession.

Woe betide dentistry if we do not measure up to the estimate which the Government has placed upon us. More and more the Government reaches out and asks us to help. It is a time of emergency and stress, and the Government has wakened to the fact that there are many ways in which we can be of service. First, it accepted the beneficent offices of the Preparedness League of American Dentists in putting the mouths of the recruits in good condition before going to the various cantonments; next, it requested that a dentist should serve on each Advisory Board in connection with the draft, and now it suggests that a dentist should also be represented in each Local Board. Be it said to the honor of many men in the profession that they have responded most loyally to these various appeals. Tens of thousands of free dental operations have been performed for the drafted men, dentists have served whole-heartedly on the Advisory Boards, and others will serve just as willingly on the Local Boards. The Dental Reserve Corps in the Army is well organized, and it is making a good impression on the War Department. Everything on the surface would seem to be working satisfactorily so far as the dental profession is concerned, but—is it?

Not one-half is being done which might be done. There are probably less than 15,000 members of the Preparedness League. This would seem to be a pretty big membership but it should be at least double that number. Thirty thousand dentists banded together in one organization would mean something. (By the way, this is the mark set for membership in the National Dental Association for the 1918 meeting, and we must reach that number). Instead of tens of thousands of free dental operations, we should have hundreds of thousands. We cannot do too much for the boys who are going to fight our battles for us. Then the work on the Advisory and Local Boards should be divided up more than it is, so that a few men are not obliged to make all the sacrifice.

The disposition on the part of some men to "let others attend to it" is altogether too prevalent. This is a time when every man must do his share. There is not a man or woman practicing dentistry today who is not capable of helping in some capacity, and there should be such a generous and spontaneous response on the part of the profession when

appeals are made on behalf of any of the War activities, that the Government will perforce be impressed with the fact that dentists are fully alert to the exigencies of the present situation, and are loyally and earnestly anxious to accept their full responsibility in the matter.

Do not wait to be asked and urged to do what is your bounden duty, but search out the ways and means by which you can do the greatest good, and then go whole-heartedly at it. Remember that while we are at heart a peace-loving people, the developments of the recent past have forced on us a terrible War, and we must see it thru to a successful issue. There is no escaping it, even if we would. And the sooner we realize the fact that the chief business of this nation at the present time is War the better it will be for us. Everything which does not contribute in some way toward winning the War is worse than wasted. At this time every bit of energy we employ for ulterior or irrelevant purposes tends to prolong the War just that much. Let this sink into our consciousness, and as a profession let us get behind the Government to a man, and prove that we are at least worthy of the confidence which the Government has reposed in us.

AMERICAN DENTISTS AWARDED LEGION OF HONOR.

A cable from Paris, under date of April 26th, announced the pleasing news to the dental profession of America, and their many friends here, that the French government had made Drs. George B. Hayes and William Davenport Chevaliers of the Legion of Honor, in recognition of their unselfish and splendid services at the American Ambulance hospital in Paris. Drs. Hayes and Davenport were placed in charge of the dental work in this hospital at the very beginning of the war and have since carried it on in a manner that has called forth much praise for their efficient management and splendid devotion to duty. They have brought to their work rare ability, and their accomplishments have merited the grateful appreciation of the French government, the medical and dental professions, and the thousands of officers and soldiers whose lives have been saved by their wonderful work. The honor conferred upon Drs. Hayes and Davenport is not only a compliment to them, but also to American dentistry. They have been splendid representatives of the American dental profession, and in congratulating them upon this well deserved honor, the profession is also to be congratulated. The work which they have done will be an incentive and encouragement to others to give the best that is in them for their Country, and for the profession which they represent.

THE HIGH HEART.

More and the more the deeper significance of the struggle in which our Allies have been engaged for over three years, and in which we are now to join them, comes home to us who associate daily with the brave men who come back for a few days from hell, to return again with strong and steadfast confidence in the ultimate outcome. How can they endure it? How can they keep on without a thought of yielding?

There is only one possible solution to this psychological problem. It is not solely a question of military discipline, of mere physical endurance. "It is the Spirit that quickeneth," as Sir Douglas Haig has always held, and who is more competent to judge? "Moral" we call it in formal definition, but it is deeper than that, for only great souls can inspire such deeds.

Much has been written about the superb courage and elan of the French and British soldier, but words are imperfect media thru which to picture them. Only one thought is uppermost as one, who has never been under fire, hears from their own lips how these brave men calmly and without fear go forward cheerfully to certain fate, led by their officers whom they trust in life and death. Yet these men are peaceful and home-loving, like our own citizen-soldiers, and do not kill for mere lust of slaughter. Those who escape, shattered and broken for life in their glorious young manhood, have no regrets that they are flung out of the battle, driftwood on the fiery waves. It was their duty and they ask no more. Wounds, agony, death—all are mere episodes, and the individual is content to be only an atom in the large design. This is what keeps them to their hard and apparently hopeless task, and this will keep them to the end.

One is silent before this. "It is high, I cannot attain to it."

We have reason to be proud of our medical reserve corps. I have talked recently with a little group of young lieutenants ill in hospital, suddenly transported from a peaceful, humdrum country practice to all the horrors of Flanders. They are all alike—they have caught the inspiration of their British comrades and have been cast in the same heroic mould. They will all return there, for they cannot do otherwise. No thought of promotion, no care for medals and decorations—only duty. Ye gods! When I think of the mushroom captains and majors at home, of the carpet-knights who are counting the cost, I wish that they could hear the experience of these boys.

Physical training and military discipline, sanitation, paper-work—

they are all right in their place, but they will be merged, in the trench and dugout, in No Man's Land, in the cold and wet and hunger, into the spirit, which alone remains.

Shall we not teach that, shall we not analyze and eliminate the causes of fear, shall we not cultivate in our young medical officers strong hearts and calm minds in every emergency, failing which all theory and practice are vain?

One's viewpoint changes over here. We wonder if we shall stand the test of battle as well as the medical officers of our allies have done and be ready, like them, for the supreme sacrifice. We must. There can be no swerving from the path that lies before us, stretching far into the unknown future and ending God knows where. The high traditions of our corps must never be forgotten. Only the high heart can keep us strong and true to the end. H. C. COE.

—*From The Military Surgeon, March, 1918.*

Army and Navy

LEGISLATION FOR INCREASED RANK FOR MEDICAL OFFICERS.

On several occasions The Journal has emphasized the importance of legislation for increased rank and authority for officers of the Medical Reserve Corps. Specifically it has urged enactment of the recently introduced Owen-Dyer Bill. It has been suggested that modification of this bill would be necessary to secure its passage, but that such modification need not be serious. In any event, some such legislation is not only desirable, but also vitally necessary if common justice is to be rendered to the Medical Reserve Corps, and if the best results are to be achieved by the Medical Department. Apparently the only active opposition thus far has come from the general staff and the Secretary of War. If the newspapers of the country mirror public opinion, certainly the public is in favor of this legislation.

As the Brooklyn Eagle says, "The logic of this proposition appeals to every mother whose son is in a home camp or in the country's service abroad. It is inexorable logic. All that the Owen Bill, now pending, does is to give Army surgeons the rank corresponding to those the Navy grants. It is not a radical, not a revolutionary measure, but it will put an end to conditions greatly injurious to the health protection of American soldiers." The Buffalo News thinks that "inasmuch as the measure is calculated to facilitate the work of the Army Medical Corps and benefit the troops by precluding dangerous delays in medical relief, etc., its passage will be welcomed and approved of by every one," and the New York Globe states that "the request of the officers of Medical Reserve Corps to be placed on the same footing as the regular Army medical officers seems to be a perfectly reasonable one. * * * The call of the Army to the medical profession has been enthusiastically responded to. * * * Remediable legislation ought to be enacted without delay and the doctors of the country should help the volunteering members of their profession to win the recognition to which they are entitled by urging their representatives and senators to support the Owen-Dyer Bill." The Chicago Herald presents the case for both sides, and states that "lives can be saved and the strength of the Army kept up, medical men think, more easily if greater power commensurate with responsibility were in the hands of the doctors and sanitarians. A decision should be reached without prejudice, and unless it can be lucidly shown that higher ranks for medical officers can have definite disadvantages, General Gorgas' bills should be enacted." The Boston Herald notes that the cream of the medical profession of the United States is now included in the Medical Reserve Corps. "They labor under a serious handicap by reason of their inferior rank.* * * Titles ought to correspond to responsibilities. * * * When we realize that in all our wars disease has been responsible

for more than 70 per cent of the morality, we can get some realization of the importance of the service which we call on the Medical Reserve Corps of the Army to render. The Philadelphia Record doubts whether Secretary of War Baker is "seriously against" the legislation. "From an unprejudiced point of view," it says "there would seem to be no good reason why physicians and surgeons who are rendering invaluable service in saving lives and protecting the health of the soldiers should not be raised to a rank commensurate with the importance of their work, especially if that is the case in other armies than our own. The opposition to this apparently simple act of justice betrays the same spirit which fought against the idea that enlisted men in the Army and Navy should be given every opportunity to rise to the highest honors."

In fact, the press is practically unanimous in favoring this legislation. With this encouragement, the physicians of the country should redouble their efforts to let Congress know that the medical profession wishes an early and favorable consideration of legislation for fair treatment of their confereres in military service—*Journal A. M. A., March 30.*

GENERAL GORGAS'S INDISCRETION.

General Gorgas has reason on his side in his efforts to correct the evils of the system of ranking in the Army medical service. This has given him courage to oppose the powers immediately over him in the War Department by an appeal to Congress direct. Such action would lead to removal in any other case but his. It is the reverse of the whole system upon which the Army is and must be built.

In the present case, General Gorgas has evidently thought the trouble great enough to justify his sacrificing his position if necessary, in order to obtain relief for his part of the military organization. His judgment of the trouble probably does not exceed the fact. The medical service needs to be run on lines of medical and surgical efficiency. Its many expert members, drawn from civil life, are subordinates in the military hierarchy. They lack the authority to make their ability count. Leaders in the medical world have become understrapers in this topsy-turvy service.

It is easy to see how General Gorgas can conceive an urgent crisis in the affairs of his branch of the service to exist. Whatever happens to him, as head of that branch, his possible insubordination should not blind Congress to the need of a reform in the medical ranking system. A prompt change may enable us to avoid the kind of tragedy that a country does not forget or forgive; a massacre of our own sick and wounded by medical inefficiency.—*From the New York Sun, March 20.*

ARMY MEDICAL CORPS LEGISLATION.

There is active opposition, on the part of the War Department, particularly the general staff, to the bills pending in Congress proposing to fix the grades of the commissioned officers of the medical corps and of the medical reserve corps of the Army on active duty. This legislation provides that one-fourth of one per cent of the officers in the medical corps shall be major generals, one-fourth of one per cent brigadier generals, 4 per cent colonels, 8 per cent lieutenant colonels, 23.50 per cent majors, 32 per cent captains, and 32 per cent first lieutenants. The surgeon general of the Army, and prominent medical men connected with the medical reserve corps, were before the Senate Military Committee recently and protested against the opposition within the War Department to this measure. General Gorgas charged that "line officers have no hesitation in ignoring the sanitary recommendations of medical officers of lower rank," and pleaded that members of the corps should

get rank commensurate with the importance of the positions they hold. The medical officers insist that they should have increased rank and authority together with absolute responsibility in matters pertaining to sanitation and preventable disease and the general health of the military forces. Major Mayo, a reserve officer, complained of the lack of centralization of power or authority, and insisted there must be such centralization to gain effectiveness. Opposition to the legislation was expressed in a communication from the Acting Secretary of War who was called upon by the Senate Military Committee for an expression of opinion in relation thereto. He states that if the medical reserve corps obtains special recognition, other branches of the service will feel discriminated against.—*Army and Navy Register, March 23.*

UNIVERSAL TRAINING FAVORED.

A significant vote occurred in the Senate yesterday when was brought up Senator New's amendment providing for universal military training, which amendment is intended to be incorporated in the revised draft law made applicable to those who came of age since the enactment of that legislation. Senator Jones, of Washington, made the motion to lay the amendment on the table, and this was defeated by a vote of 35 to 32, indicating that senatorial sentiment inclines toward universal military training, concerning which the administration has expressed its disapproval. Senator Jones inquired of the chairman of the military committee whether the Secretary of War or the chief of staff had been before the committee on the subject or had recommended the enactment of this provision. Mr. Chamberlain admitted that the committee had not particularly considered the New amendment and that no formal expression had been obtained from the War Department or the general staff. He added, however, that the committee had authorized Senator New to offer the amendment on the floor; whereupon Senator Jones protested against the consideration of the measure at this time, believing that it was a measure entitled to careful consideration on account of its importance. — *Army and Navy Register, March 30.*

DRAFTED MEN SHOW PHYSICAL DEFECTS.

Examinations of men of military age in the selective draft have shown that a large number of these have been rejected because of physical and mental defects which had their origin in the period of growth and development. Many of these defects were preventable and could have been avoided if proper remedial measures had been taken during childhood. Therefor the development of measures for improving the physical and mental supervision of children during school age is considered, by the Public Health Service, one of the most immediate means for improving the physical condition of the people. Congress has been asked to appropriate $100,000 for special studies of and demonstration work in school and mental hygiene. No part of the appropriation is to be available for this work in any community unless the state, county, or municipality in which the community is located agrees to pay one-half the expenses involved.—*Army and Navy Register, March 30.*

WAR DEPARTMENT OPPOSING OWEN BILL.

The war department is actively opposing the Owen bill to increase the rank of medical officers in spite of the urgent recommendation for its passage made by Surgeon General Gorgas and other distinguished physicians and surgeons. Assistant Secretary of War Crowell protests that it would do a grave injustice to officers of other reserve corps because they do not attain the rank sought for

the medical officers. Secretary Baker is said to concur in this view.

As a general rule every one would subscribe to the principle that the higher commissions ought not to be awarded to men outside the fighting service. But in the case of medical officers a very special exception must be made. If the war department declines to make that exception, its attitude can be explained only as an inheritance of an antiquated military tradition.

It is hardly necessary to observe that the health of an army is one of the most potent factors in its success. It is likewise quite clear that the sooner wounded men can be made fit again, the stronger the battle line. The Germans have not bombarded hospitals merely for the pleasure of killing wounded men; they have done so to prevent these men from taking their places in the trenches again. Their purpose is still further served if they succeed in killing medical officers. Anything that impairs the medical service impairs the efficiency of the army.

Surgeon General Gorgas says the efficiency of the medical service cannot be raised to the highest level under present conditions. His contention is fully sustained by our own past experience and that of other nations. It is a matter of record that army officials have often disregarded the warnings and advice of army surgeons, not because of military necessity, but because of negligence, inattention, or worse. The medical officer, more often than not, was a nuisance until the men were on the point of death. During the Spanish-American war the recommendations of the army surgeons were repeatedly ignored, with the result that thousands of men died from disease to every one that died from wounds. The British commissions that investigated the Mesopotamia fiasco attributed that failure in a large measure to a similar disregard of medical considerations.

In the Spanish-American war and in the Mesopotamia campaign the medical officers were handicapped by their inferior rank. Their recommendations failed to carry weight because their rank carried little authority. A general officer felt perfectly free to ignore the advice of men in distinctly subordinate positions, even if these men were distinguished physicians and surgeons.

The British have learned their lesson. The rank of British medical officers now is practically on a parity with the rank of officers in military service. The French have the same system. American medical officers in France suffer not only from the initial disability of inferior rank but also from the unjust and perhaps humiliating sense of inferiority that inevitably rises in their association with the British and French.

Dr. Mayo put the case succinctly when he said that over there they looked at the uniform and not the man inside the clothes, adding that the man could get any further than the clothes he wore entitled him to get, no matter how great his reputation at home.

For the protection of our soldiers, if for no other reason, the Owen bill ought to pass.— *Editorial, Chicago Tribune, March 25.*

ARMY DENTAL CORPS.

Under a recent decision of the War Department the dental corps of the Regular Army is entitled to about 300 officers, or about 90 more than it now has. Recently some 200 candidates for the appointment to this corps were examined, but the marking of the papers has not been completed. It is expected that a sufficient number will be found qualified to fill the vacancies. The national defense act of June 3, 1916, fixed the strength of the dental corps on the basis of one for every thousand of enlisted men of the line of the Army. This was amended by the act of October 6, 1917, which provides that there shall be one dental officer for every thousand of the total strength of the Regular Army (commissioned and enlisted, line and staff) authorized from time to time by law, and

that the dental corps shall consist of commissioned officers of the same grade and proportionately distributed among such grades as are now or may hereafter be provided by law for the medical corps.

LETTER FROM PATRIOTIC DENTIST.

St. Paul, Minn., March 9, 1918.

Dear Doctor King:—I am sending you a picture. Don't you think this picture would interest the many readers of The Journal, especially at this time? This picture is one of myself taken in camp;

my chair is strictly home-made and my instrument case, you will note, is a cigar box.

I enlisted as a private in the Spanish war in 1898 and served until mustered out, my salary being $15 to $18 per month. Practically all of my professional services while in the Army were "thank you" jobs. I furnished all materials and instruments but the forceps, extractions were always filled; on rare occasions, I would receive twenty-five cents for a particularly difficult filling. I was not in service long before it was known thruout our Army Corps that there was a dentist in the ranks and from that time on, I was frequently called upon, even during the night, to give relief to men suffering from tooth troubles, and I might add that only within the past year have I examined some of the fillings I put in during my service with the colors and have found them doing good service.

Because of my age and because I have served my country once in the ranks, I have made application for a commission as Dental Surgeon in the Dental Reserve Corps. I am anxious to help the good old U. S. A. and I believe I am entitled to a commission.

Yours respectfully,

W. O. ASSEIN,
1045 Hastings Ave.

SHOOT THE SPIES!

The developments of the last two weeks have indicated that there is an increasing number of spies and enemy agents engaged in active operations in various parts of this country. There have been revelations of the presence of these persons in many of the principal plants where are manufactured airplanes, shells, and other materials needed in Europe. It seems to be possible for men to get into the factories and do damage to the product. There has long been a suspicion that the industry of the Germans in that direction was persistent, skillful. and successful. The only consolation at present is that some of the offenders are being identified, if they are not being adequately punished. There would seem to be no good reason why the government should not execute, with as little delay and formality as is consistent with the regularities of such a transaction, those who have been convicted of such atrocities as have been described recently in the newspapers. That process would remove effectually and permanently people who are materially aiding the enemy by secretly murderous methods, and would serve as a fine, and probably effective, example. to those who are inclined to continue that class of work. An individual capable of such destruc-

tion has exceedingly little to fear from the present lenient policy. He might fare worse by committing a minor offense against law and order. A few shots accurately and discriminately placed would have an exceedingly wholesome effect.—*Army and Navy Register, April 6.*

ARMY MEDICAL DEPARTMENT.

While nothing official has yet been vouchsafed in regard to the decision of the War Department as to the total enlisted strength of the Army, which is to be the basis of the commissioned personnel of the medical department of the regular establishment, it is understood that the ruling, which may be expected during the coming week, will announce this total enlisted strength as 286,000. There will be, accordingly, an excess of colonels and lieutenant colonels owing to the fact that the numbers in those grades as now existing were based on a strength of 300,000. The excess number will, of course, have to be absorbed, but as there are a number of retirements in prospect during the next few months the situation will not be a difficult one to adjust. There are now 883 officers in the medical department, including those who have been recently recommended for appointment; and on the basis of the prescribed total enlisted strength there will be in the neighborhood of 1,000 vacancies to be filled. The dental corps, now consisting of 209 officers, is entitled to some 90 more in view of the fact that the personnel of that branch is founded on the total strength of the Army, estimated at 300,000, instead of the total enlisted strength. In the examination which was recently held, the results of which are to be made known in the next few weeks, it was announced that the candidates found qualified would be afforded the opportunity of appointment to the restricted degree of not more than three or four vacancies. A large number of candidates had previously applied for the privilege of taking the examination, and when it became known that the vacancies were so few in number many of them declined to enter the competition. Since then, it is promised, there will be nearly 100 vacancies to be filled, and probably there will be much discontent expressed when it is known that there were a larger number of vacancies than was at one time in prospect. — *Army and Navy Register, April 6.*

SALUTE THE FLAG.

It may be necessary to resort to compulsion to insure proper respect for the flag. While our soldiers are dying for that flag it is unseemly that any one in this country should omit the salute that is at the same time an indication of allegiance and a tribute to the fighting men.

We may be certain that no one in Germany fails to exhibit respect for the Teutonic red, white, and black. It may be contended that the Germans do so under compulsion, that they are secretly in revolt against the symbol of Hohenzollern rule. One of our war aims is said to be the reformation of the German Government; we would bring freedom to the exploited and subjected German masses.

We call our flag the flag of freedom; it is the banner of liberty and democracy. If our affection for it stops short of a simple observance such as a salute, what may be surmised as to our attitude towards the things it symbolizes? Germans might well be skeptical of the advantages of our form of government if we hold its emblem in so low esteem.

The truth is, of course, otherwise, tho excuses do not excuse. The failure to salute the flag relates rather to bad manners, inertia, and stupidity than to lack of loyalty and patriotism. If this were not the case the government might as well go out of business tomorrow.

We are proud of our freedom. But when we make use of it to misprize its symbol we have to that extent forfeited

our privilege. If Americans cannot voluntarily perform the necessary observance of the salute then some effective remedy must be found. If our bad manners, our inertia, and our stupidity are so great that we cannot remove our hats as the flag passes by we shall have to resort to military regulation. Chief Alcock might make a beginning by teaching the police to set a proper example.

While our men are fighting, while the security of our nation is at stake, the flag must be saluted. — *Chicago Tribune, April 13, 1918.*

AGAINST MEDICAL CORPS LEGISLATION.

The War Department is against the enactment of the Senate bill (3748) fixing the grades of the commissioned personnel of the medical corps and of the medical reserve corps of the Army. The acting secretary of war regards the proposed legislation as "highly undesirable" and has urged that it "be not favorably considered." Assuming that the number of medical officers on active duty will soon reach 70,000, Mr. Crowell states that "this would provide for 100 general officers, 800 colonels, 1,600 lieutenant colonels, and 17,500 officers in the lower grades." Commending on this situation, he says: "The number of officers in the higher grades provided by this proposed legislation would be far in excess of the number authorized for service with troops and would give greatly increased rank to officers serving with non-combatant troops over those serving with combatant forces, which is manifestly contrary to the prevailing views as to what is equitable and right." Attention is also called by Mr. Crowell to the fact that "all other sections of the reserve corps of the Army limit the highest grade to that of major, and to include the medical reserve corps of the Army in this proposed legislation would result in not only the abnormal and unwarranted promotions, but would give officers of the medical section of the reserve corps higher grades than provided for any other section of the reserve corps, which would be a manifest injustice."—*Army and Navy Register, April 6.*

ADDITIONAL DENTISTS FOR DIVISIONS.

Authority has been given by the War Department for increase of the allowance of dental personnel for the divisions about to depart for France. Such divisions will have 31 dental officers and 32 enlisted men as dentists' assistants, in place of the former allowance of 25 of each class. The allowance of dental officers as prescribed by law for the Regular Army is one per thousand of the regular commissioned and enlisted personnel of the line and staff, and this ratio has been maintained in placing members of the dental reserve corps and of the dental corps of the National Army on active service. The dentists believe that this allowance is too small, and basing their estimates on the average in private practice they are advocating an allowance of three dental officers per thousand of the personnel of the military establishment. The allowance of 31 dental officers to an overseas division gives less than two per thousand. A new class of recently appointed members of the regular dental corps and of the dental reserve corps will commence a two months' course of instruction at Fort Oglethorpe, Ga., on April 15.—*Army and Navy Register, April 6.*

SHALL VENEREAL DISEASE MENACE THE NATION?

The Council of National Defense urges public officers and citizens of the United States to employ every means possible in the repression of prostitution and the control of venereal diseases, for the following reasons:

First, because we must prevent such

conditions as have developed in Europe since the beginning of the war.

(1) "The number of syphilitics in the army must certainly be several hundreds of thousands.* * * Since the war began, a total equivalent of sixty divisions have been temporarily withdrawn from the fighting for venereal diseases." (Vienna report)—Journal of the American Medical Association, March 10, 1917, Vol. 68, No. 10, p. 814.

(2) "During the first eighteen months of the war one of the great powers had more men incapacitated for service by venereal disease contracted in the mobilization camps than in all the fighting on the front."—Social Hygiene, Vol. 3, No. 2, p. 205.

(3) "In the war zone of France there has occurred an alarming increase of venereal disease both amongst the soldiers and the civilian population."—The Medical Officer (London), No. 499, March 3, 1917.

(4) "The failure of the * * * Government to protect their soldiers from these evils (sexual vice and alcoholism) is the gravest error that the Government has committed; for these vices have proved more destructive to the * * * people since August, 1914, than all the * * * artillery, rifles, hand grenades, poisonous gases and fire blasts. Those killed by shot and shell transmit no poison to their families and descendants—the victims of alcohol and prostitution do."—From a letter by President Emeritus Charles W. Eliot, of Harvard University, quoted in the Survey of September 8, 1917.

(5) "Thousands upon thousands are withdrawn from the fighting army for weeks. But they are not only missed as fighters, they also cause expense and great obstruction thru their transportation back home and thru the necessity of establishing hospitals for thousands who were not wounded by the enemy. They burden the doctors so necessary for the care of the wounded. * * *

"But the very worst part of the venereal diseases is not the diseased condition immediately following infection, but the ailments frequently developing in later years, when the war is long past and the old infection already forgotten, and the transmission of the disease to the family after the return of the troops to their homes."—Prof. Albert Neisser, Frankfurter Zeitung, January, 1915.

Second, because serious conditions have already developed in the United States Army, due largely to conditions in civil communities.

(1) At one National Guard camp, 502 new cases of venereal diseases were reported in one week.—Official Bulletin, November 20, 1917, p. 6.

(2) It was found that most of the cases at one large cantonment originated, not in the camp or near the camp, but in civil communities from which the men came or thru which they passed on the way to camp.

(3) "In the case of all the troops on the border, a vastly larger proportion of venereal disease was contracted before reaching the border than was contracted afterwards."—*Social Hygiene, Vol. 3, No. 2, p. 220.

Third, because the War Department has asked our aid.

(1) "Our responsibility in this matter is not open to question. We cannot allow these young men * * * to be surrounded by a vicious and demoralizing environment, nor can we leave anything undone which will protect them from unhealthy influences and crude forms of temptation."—Secretary of War Baker in his letter of May 26, 1917, to Governors of all states.

(2) "We are not going to be able to obtain the conditions necessary to the health and vitality of our soldiers, without the full cooperation of the local authorities in the cities and towns near which our camps are located or thru which our soldiers will be passing in transit to other points."—Ibid.

Fourth, because venereal diseases result in the infection of innocent women and children.

(1) "No disease has such a murderous influence upon the offspring as syphilis; no disease has such a destructive influence upon the health and procreative function of women as gonorrhea. * * * Inherited syphilis constitutes a powerful factor in the degeneration of the race."—Prince A. Morrow, M. D.; Social Diseases and Marriage, Chap. 1.

(2) "All previous war experience shows an increase of venereal disease. * * * When peace comes there is a danger of grave and widespread dissemination of these diseases. It is for that that we must be prepared and there is no time to be lost."—Report of National Conference for Combating Venereal Diseases (London), Social Hygiene, Vol. 3, No. 2, p. 235.

Fifth, because prostitution is not a "necessary evil."

(1) "Sexual intercourse is not necessary to preserve health and manly vigor." Moss: Manual of Military Training, Section 1466, p. 522. See also statement signed by Walter B. Cannon, M. D., Harvard University, William H. Howell, M. D., Johns Hopkins University, and 355 other foremost medical authorities in the United States."—M. J. Exner, M. D.: The Physician's Answer. (Association Press, New York), pp. 14, 24-51.

Sixth, because the "restricted district" and other attempts to regulate prostitution, have proved ineffective.

(1) See Flexner: Prostitution in Europe, pp. 175-6, and the reports of Vice Commission in Chicago, Minneapolis, Syracuse, Philadelphia and many other cities.

Seventh, because repression is the only feasible method.

(1) "The only practical policy which presents itself in relation to this problem is the policy of absolute repression, and I am confident that in taking this course the War Department has placed itself in line with the best thought and practice which modern police experience has developed."—Secretary of War Baker in his letter of August 14, 1917, to Mayors and Sheriffs.

(2) "This policy involves, of course, constant vigilance on the part of the police, not only in eliminating regular houses of prostitution, but in checking the more or less clandestine class that walks the streets and is apt to frequent lodging houses and hotels."—Ibid.

Eighth, because it will be better to handle the situation locally and thus make military interference unnecessary.

(1) "One Commandant issued orders forbidding all use of intoxicating liquor and all patronizing of immoral resorts. Every woman who got off a train was watched until her business was known. If necessary, she was put out of the vicinity."—Social Hygiene, Vol. 3, No. 1, p. 155, also Association Men (New York), April, 1917, p. 379.

(2) "If places of bad repute spring up outside the 5 mile limit, but fairly accessible to the camp, I shall not hesitate to insist upon their elimination."—Secretary of War Baker in his letter August 14, 1917, to Mayors and Sheriffs.—*Social Hygiene Bulletin.*

NEW HEAD FOR ARMY MEDICAL CORPS.

Altho some time must elapse before there is a vacancy in the office of the surgeon general of the Army considerable gossip is rife as to the successor of General Gorgas when he shall reach the retiring age in October. It is, of course, by no means certain that another officer will be selected in his place, and there are indications that, if General Gorgas desires to remain on active duty, he will be continued after the date of his retirement as head of the Army Medical Department. There are, also, evidences in plenty that a faction of the prominent and influential army medical reservists is in favor of the selection of one of their number to succeed General Gorgas, in

which event the new appointee would be assigned to duty as "acting" surgeon general of the Army. If a reservist is chosen, it will probably be Dr. Franklin H. Martin, secretary-general of the American College of Surgeons, chairman of the general medical board of the Council of National Defense and a major in the medical reserve corps, who is understood to be active in his own behalf as well as being conspicuous and industrious in framing and advocating certain pending legislation in relation to the medical department, to which objection has been expressed by the War Department authorities. Maj. Martin is regarded by members of his profession as a keen politician as well as a distinguished physician, and he has been much in evidence in Washington in various ways in an effort to bring under his subcommittee of the council of national defense some of the activities of the surgeon general's office as well as that of the bureau of medicine and surgery of the Navy Department, without, however, much success as to the latter branch. He is even credited with a plan for consolidating the army medical department, the naval medical corps, and the Public Health Service in forming a new executive department, that of public health and sanitation, and the opponents of that particular project imagine, or at least allege, that Major Martin's ambition to become the acting head of the army medical department is intended as a step toward the realization of his plan. If the successor of General Gorgas is an officer of the regular medical corps the selection may involve the consideration of General Charles Richard, National Army, and General William H. Arthur, National Army, who are colonels in the regular medical corps; Colonel Guy L. Edie, who is in France; Colonel J. R. Kean, who is on duty in France; General M. W. Ireland, of the National Army, who has been made surgeon general of General Pershing's forces, and General Francis A. Winter, of the National Army, who is on duty in France, both officers having recently received commissions in the National Army, and Colonel Robert E. Noble, who is the director general of base hospitals.—*Army and Navy Register, May 11.*

RECONSTRUCTING DISABLED MEN.

If the bill now pending in the Senate (S. 4284) becomes a law, this government will be in a position to render the same useful service to its disabled fighting men that is being performed with such conspicuous success by most of the other belligerent countries. This bill, which was prepared by the Federal Board for Vocational Training, provides the machinery for carrying out the plan of vocational rehabilitation of injured men which has been worked out with considerable detail by that board. All medical and surgical treatment necessary to give functional and mental restoration before the men are discharged from the military service will continue under the control of the War and Navy Departments. In order to simplify the work of rehabilitation, and reduce the personnel to a minimum, it has been decided that the medical and hospital treatment of injured sailors will be furnished by the medical department of the Army; in fact, a number of disabled sailors, notably blind men, have already been turned over to the Army medical authorities for the course of prevocational treatment specified for soldiers. While the men are under treatment they will continue in a full-pay status, including the family allowances provided in the war insurance act; but if a man fails or refuses to follow the prescribed course of vocational instruction, any part or all of his monthly compensation may be withheld. An appropriation of two million dollars is included in the bill, which covers the employment of teachers, the cost of necessary facilities for conducting the schools, the travel, lodging, and subsistence of dis-

abled students in pursuing their training, and of placing the rehabilitated men in gainful occupation. In the latter object, the board for vocational education will have the cooperation of the Labor Department. The bill was introduced by Senator Smith, of Georgia. — *Army and Navy Register, April 20.*

SOCIAL HYGIENE DIVISION.

The War and Navy Departments Commissions on Training Camp Activities have formed a social hygiene division under the head of Major William F. Snow, of the Surgeon-General's Office. The work of the division will be entirely educational, and will be divided into three sections with Dr. Katherine B. Davis, William H. Zinsser and Lieut. Walter Clarke as directors. Lieutenant Clarke will continue the educational work that he has been doing in the cantonments with the full cooperation of the War Department and with a large staff of lectures on social hygiene. The lectures are compulsory with the men in the camps, and exhibits and literature are used in connection with them. The section on men's work under the direction of William H. Zinsser will concern itself with the education of men in civilian communities. This work was formerly under the direction of the Council of National Defense, but is now transferred to the social hygiene division under the Commission on Training Camp Activities. Dr. Katherine B. Davis will direct the section on the education of women and girls. A lecture bureau will be maintained in cooperation with the social morality committee of the war work council of the National Y. W. C. A., the American Social Hygiene Association and similar organizations, which have also previously cooperated with the other sections named. This bureau will supply lectures to groups of women and girls and will work in industrial communities as well as in communities adjacent to camps.—*Journal A. M. A., April 27.*

NEW NAVAL HOSPITAL FACILITIES.

Surgeon General Braisted of the Navy has completed his plans for additional accommodations at the naval hospital. There have been provided at various places 15,000 beds and it is intended to increase this by 8,000 beds, together with 3,270 beds for the use of the hospital personnel. Provisions will also be made for the shelter of medical officers and hospital corps men in the different camps and stations, so that this personnel may be quartered within convenient distance of the patients who are under treatment and also avoiding the difficulties which occurred last winter when travel between widely separated points was seriously interrupted by the bad storms. The naval medical officers are in charge of two hospitals in France each of 500 beds, and arrangements are being made to establish three such hospitals, with 1,000 beds, in England, the delay being due to the difficulty in finding entirely suitable sites. —*Army and Navy Register, April 20.*

AMERICAN MEDICAL OFFICERS UNDER FIRE.

Press dispatches call particular attention to the actions of American physicians and nurses in the midst of the great drive now taking place on the Western battle front. They reveal that the medical officers conducted themselves with exceptional bravery and coolness while under fire. As the Germans advanced it became necessary for casualty clearing stations and field hospitals to retire. How difficult a task this was may well be convinced by any one with a knowledge of what it means to transport thousands of wounded and tons of equipment while under fire and along roads jammed with the tremendous paraphernalia of the fighting army. It is reported that when the offensive opened the British had large advance stations which came under immediate pressure. While shells

and bombs rained on the hospitals, the physicians and nurses continued to attend the wounded, to pack supplies and to arrange for transportation. The severely wounded were carried back in ambulances, but every man able to walk was forced to transport himself back to his new station. It is reported that the more valuable surgical instruments and supplies were taken in charge by physicians who in many cases personally piled them on wheeled stretchers and pushed them for long distances.

MEDICAL CORPS INCREASE.

The War Department has not yet rendered a decision in regard to the "strength of the Army" in its relation to the authorized number of officers in the various grades of the regular medical corps and the regular dental corps of the military establishment. Upon this interpretation of the law will depend, of course, promotions in those branches, as already explained in these columns. The pending legislation in behalf of the medical department embodied in the Owen and Shields bills has been the occasion of animated discussion at the capitol. The opposition of the War Department to both measures, and notably to the Owen bill, has had the effect of postponing committee approval of the proposal. At the same time, considerable pressure has been applied, mostly by officers of the medical reserve corps, to secure senatorial adoption of the measure. There will probably be an attack on the provisions of the Owen bill on the floor, if it is reported from committee, on the ground that it would unduly increase the commissioned personnel of the medical department, the number of general officers being, for example, 68, about equally divided between the grades of major general and brigadier general. The influence of the medical reservists, now numbering some 16,000, is naturally formidable and will count for much in the contest with the general staff. But from present indications, if anything is reported from the Senate military committee on the subject, it will be a modification of the Owen bill.—*Army and Navy Register, April 20.*

NAVAL DENTAL CORPS.

The Navy Department has decided that the act of August 29, 1916, does not, of its own vigor, vest in an acting assistant dental surgeon, appointed under the act of August 22, 1912, the office of dental surgeon (permanent) with the right of advancement to the rank of lieutenant after five years' service (including service as an acting assistant dental surgeon.) The power of appointment was left where it would have been without the specific provision made in this case, namely, in the President.—*Army and Navy Register, April 27.*

DENTAL CORPS ORDERS FROM WAR DEPARTMENT.

DENTAL RESERVE CORPS.

Following appointments (promotions) announced:

To be majors: 1st Lieuts. Earl C. Braniger, Henry W. Rich, and Guy P. Bannister.

To be captains: 1st Lieuts. John P. Garriott, Jesse L. Meredith, Alphonse L. Senecal, William V. Thompson, Thomas M. Terry, Smith C. Tanner, Walter F. Clayton, Robert H. Nones, jr., and Royal E. Wight.

Capt. Walter Sorenson to Fort McHenry, Md., general hospital 2, for duty.

—*Army and Navy Register, March 30.*

The following appointments (promotions) announced: To be captains, 1st Lieuts. James B. Davidson, Arthur Lankford, John F. Ackley, Rae P. McGee, Wm. C. Speakman, Stewart D. Ruggles, Gerald G. Burns, Harry B. Butler, Gregory P. Cassiday, James L. Clements, Roscoe L. Barber, George H. Hewey, Ozias Paquin, Jr., Nathaniel Barnard, Leonard G. Mitchell, Edward E. P. Sleppy, Frank D. Pierce, Robert R. Luce, Frank P. Gormley, John J. W. Ross and Ivan E. Smith.

—*Army and Navy Register, April 13.*

Capt. Wm. E. Beard to Fort Leavenworth for duty.

Capt. Claude L. Hunsicker to base hospital, Fort Des Moines, for duty.

Appointments of 1st Lieut. Wm. McDougall to

captain announced. Appointments of 1st Lieuts. James P. Harper and William A. Heckard to major announced.

Appointments of following named first lieutenants to captain announced: James H. Reid, Henry D. Rand, Ormsby Keselring, Paul S. Harner, Lloyd W. Bentley, Frank A. Clear, Weston B. Estes, Edward B. Lodge, Crittenden Van Wyck, Charles A. Couplin, Joseph P. Collins, Franklin M. Huson, David A. Proctor, Fred C. Sizelan, Charles Steffens, Douglas D. Godwin, William A. Spence, Lee F. Strickler, James A. Johnson. Carl A. Anderson, Herman E. Tipton, Chester M. Meares, Earl J. Hill, Mildfred I. Merritt, Thomas F. Montgomery, Harry F. Gravelle, Earle N. Hoopman, and Joshua H. Gaskill.

—Army and Navy Register, April 20.

The following appointments announced: To be captains: 1st Lieuts. Guy W. Angelo, Edward R. Danforth, Charles J. Denholm, James B. Harrington, Frank E. Hendrickson, Miguel W. Jackson, James B. Jones, George R. Lee, Ralph D. Linn, Elbert W. King, Frank B. McAdams, Earl N. McCue and Forest DeW. Suggs.

—Army and Navy Register, April 27.

The following appointments announced:

To be major: 1st Lieut. Otis H. McDonald.

To be captains: 1st Lieuts. Clarence J. Appelget, Albert J. T. Beatty, John E. Frates, Walton J. Graft, John W. Leggett, William B. Ley, Claude E. Markey, Wegor E. Mathison, Robert W. Meeker, Clinton T. Messner, Henley E. Miller, William L. Nance, Gilbert L. Walker, Raymond L. Anglemire, John T. Ashton, George F. Brand, Thew J. Ice, Clarence P. Jackson, George F. Brand, Thew J. Ice, Clarence P. Jackson, Justin E. Nyce, Harry W. Porter, Floyd D. Soverel.

—Army and Navy Register, May 4.

The following appointments announced: To be Majors—Captain Leonard G. Mitchell and 1st Lieut. Clement V. Vignes. To be Captains—1st Lieuts. Herman J. Brachman, James A. Campbell, Gordon B. Logan, Daniel F. McCarthy, Harold J. McGinn, Leon Reisner, Arthur C. Roblin, Wm. R. Snyder, Norman C. Spencer, Harold A. Stone, Harry M. Trafford, Harold Van Biarcom, Carl G. Anderson, Roy L. Bodine, Frank W. Boville, Merle W. Catterlin, Hubert F. Christiansen, Frank L. Cooper, Fred W. Dains, Samuel H. Davis, Pearley M. Fugler, George L. Gallagher, Grant C. Gentry, George R. Heap, Charles S. Irwin, Francis M. Kane, Chester K. Little, Otho L. McKay, Thomas G. McMartin, Seymour S. Skiff, Wm. J. Stark, Charles R. Wagner and Raymond H. Williams.

Capt. Walter F. Clayton at Camp Sevier, S. C., report for duty in base hospital.

—Army and Navy Register, May 11.

Following appointments (promotions) announced: To be captains: 1st. Lieuts. Perry Haskell Plummer, Kenneth F. Smith, Austin R. Killian, John C. Gallagher, and Frank W. Gale.

—Army and Navy Register.

DENTAL CORPS.

Col. Wm. H. Chambers from duty at Presidio of San Francisco to Fort McPherson, general hospital 6, for temporary duty.

—Army and Navy Register, March 30.

Col. Wm. H. Chambers from duty at Presidio of San Francisco to Fort McPherson, general hospital, for duty.

Col. Julian R. Bernheim report to surgeon general for duty in his office.

Leave for three months granted Maj. J. Craig King on surgeon's certificate.

1st Lieut. Wm. F. Wieck to Fort Oglethorpe for course of instruction.

—Army and Navy Register, April 13.

Maj. Gerald D. Byrne from duty at Lettermann General Hospital. San Francisco, to Fort Riley, Camp Funston, for duty.

The following to Fort Oglethorpe, medical officers' training camp, for course of instruction and return to stations: Majs. Earp T. Dickmann, Wilfurth Hellman, Samuel Kaufman, Charles C. Mann, Lee B. Schrader, Walter S. Smith and George R. Tressel, 1st Lieuts. Alvin E. Anthony, Wm. J. R. Akeroyd, Leslie D. Baskin, Clinton R. Boone, Joseph L. Boyd, Wm. B. Caldwell, Dell S. Gray, Curtis W. Hallam, Timothy Harden. Leslie S. Harlan, Winfred E. Henshaw, Claude R. Hollister, Glover Johns, Roy M. Kisner, Timothy F. Leary, Milton A. Price, Joseph L. Ralm, Samuel J. Rohde, Walter A. Rose, Wm. H. Sicfert, Alexander M. Smith, Jr., Boyd L. Smith, Edward A. Thorne, Wm. T. Williams, Clarence J. Wright and Cecil R. Hays.

—Army and Navy Register, April 20.

1st Lieut. William A. Moore to Fort Crockett, Texas, for duty in coast defenses of Galveston.

—Army and Navy Register, May 4.

Relief Fund Department

January 11, 1918.

Dr. Edward S. Gaylord, Chairman,
National Relief Fund.

Dear Doctor Gaylord:

At a meeting of our local society last night our attention was directed to the condition of a Doctor, of Bellingham, Wash., who it appears is having a hard struggle with tuberculosis. He is reduced to poverty and his young wife caring for him and their baby and also working in a brick yard trying to prevent actual starvation.

We passed the hat and raised almost ONE HUNDRED dollars which will tide them over for a little while..

Then one member took the floor and expressed wonder if this was not a case which might be helped by our National Relief Fund. After some discussion I was appointed to find out.

The young man graduated in 1913, does not belong to the National Dental Association, but I have it from several of his class mates that he is worthy of any help which you may be able to render.

I have had a number of our men during the past few years ask me where this dollar goes which they are asked each year to send for relief fund stamps?

The handling of this case would be a very lively illustration and explain better than any mere words of mine.

We may be out of order, but we want to know definitely.

Hoping all good things are coming to you this year, I am

Cordially yours,

GEO. T. WILLIAMS.

New Haven, Conn., Jan. 19, 1918.

Dear Dr. Williams:

Your letter of the 11th inst. is just received. I am very glad to make immediate reply.

First, I take off my hat to such an organization as your local society. You men have hearts that can be reached by a suffering brother, and I say in all sincerity, God bless you, every one. What a noble contribution, and how the heart of Dr. ———, and all members of his family must have swelled in appreciation, and proud to be reckoned as member of a profession where such fraternal sympathy can be aroused. This loyalty exists among our profession as a whole, but in the great race and bustle for existence, the spirit wanes, and too often the other fellow is forgotten, but I am glad to say each year the Relief Fund Committee is encouraged by substantial evidence, our members are recognizing a duty which in a few years will come back to them in double compound interest of satisfaction for having assisted to establish a fund which shall in reality be a first and second aid.

Briefly then, my dear Doctor, the situation is this: the National Association,

for the past seven years have been trying to get together a sum, the earnings of which shall be subject to call for the relief of our members who from sickness, aged and infirm, or accident, are unable to care for themselves or families.

We have employed several methods to interest our members, but have at last settled down to the Red Cross idea to send out Xmas seals, and ask for one dollar, from every member to build up a sum of fifty thousand dollars, which at 4 or 5% would furnish a sufficient sum to begin the work of relief.

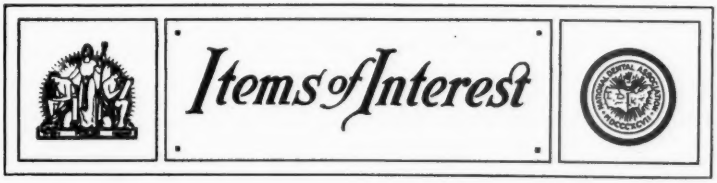
We are now approaching thirty thousand dollars, cannot state definite, as we are still receiving returns from the seals. We hope to exceed thirty thousand dollars this year, (see report of Committee in the December number of The Journal, pages 1328-1329.)

From a business stand we cannot respond to your call, and others we are constantly receiving.

I regret being compelled to make such reply to your appeal, if our members (we now have about twenty thousand members) would contribute the small sum asked, we would this year have the fifty thousand, and next year begin the work of relief.

Very sincerely yours,

Signed: EDWARD S. GAYLORD,
Chairman Relief Fund Committee.



NOVOCAIN-SUPRARENIN SOLUTION.

Editor of Journal of the National Dental Association:

Dear Sir:—The instability of the Novocain-Suprarenin Solution, made by dissolving the tablets supplied by the manufacturer of the drug, is one of the few disappointing things which is associated with its use in dental practice. Therefore, it seems to me that any method of preparation which adds to its stability, ought at once to be known by every operator who employs it in his work.

In the first place, it is our belief that a stock solution of Ringers dissolving fluid should never be used, and if the following method is followed, fresh Ringers Solution can be made each time the drug is desired and no more time consumed than when the stock solution is kept on hand.

Buy a few graduated test tubes of the best quality glass—to hold about twenty c. cs. Pour in 10 c. cs. of sterile distilled water and add one Ringer tablet. Boil over gas or alcohol flame. After the syringe has been thoroly washed with alcohol followed by sterile distilled water, use the surplus Ringers for a final washing of same. To the remainder, according to the amount desired, add the Novocain-Suprarenin tablets and boil over flame in the tube.

A test tube just large enough to admit the barrel of any of the standard syringes is essential, so that the solution may be drawn directly into the syringe without being transferred to a shallow cup, which transfer makes contamination possible; if only by increasing the liquid surface exposed to the impurities in the air.

As soon as the syringe is filled, stop the mouth of the tube tightly with sterile cotton, thus effectively shutting out all floating air impurities.

By using the test tube for mixing as above described, we have frequently kept Novocain-Suprarenin Solution over night and found it the following morning absolutely lacking the slightest tint suggestive of decomposition.

This result is not invariable, for the compounded tablets are themselves sometimes on the verge of decomposition when taken from the tubes and must be discarded. But a sufficient percentage of successes to justify the method will result and the whole time consumed is no longer than when the stock Ringers Solution is used with the open mixing cup.

Trusting you may consider this sufficiently important to convey to your readers, I am,

Sincerely,

D. B. WILLIAMS,
76 West Northampton St.,
Wilkes Barre, Pa.

IDEALS AND IDEALISM.

By John E. Gurley, D. D. S.

An ideal is a model or a type which exists only in the mind, and idealism is a quest of ideal perfection. The life of man has many complexities. But it is absolutely essential that he have an ideal, and that he strive to attain it.

We live and have our being—we know not whence we come nor whither we go; we ask, why are we here? Concerning the coming and going of man, we may think but little, even dare contemplate, not at all. But "why are we here," is a question that all attempt to answer, either by word or action.

The philosopher tells us that the mind of man has three aspects, the scientific, which seeks the truth, the artistic, which seeks the beautiful, and the religious, which seeks nobility. To the observer, it would seem that this must have been declared in the long ago, and that the correct division of the mind of man is now into two aspects—the professional and the commercial.

Thru the professional aspect, service to mankind is rendered, and this is of many varieties, while thru the commercial, all men strive to gain wealth.

The American people are criticised today for the extremes to which they go in pursuit of the dollar. These ideals or principles are inculcated into the minds of the oncoming generation, witness a serial in the Saturday Evening Post, "If I Were Twenty-one," the author says, in encouraging young men to work on a commission basis: It fastens upon you a fever to achieve results which can be definitely measured by a dollars-and-cents standard. It does that, or else it shows you that you can't qualify as a result getter and that destiny has marked you as a *genius* (italics ours), or else has decreed that you become a bill clerk or a bookkeeper."

Now, then, is yours a dollars-and-cents standard or a service standard? Are you interested only in the commercial aspect of things? Or will you take a hand in the service of the other fellow? The editor of the Dental Review has struck the nail squarely on the head. "As a professional man the world expects more of you in the way of high ethical conduct than it does of the merchant or tradesman, and justly so. * * * Your obligation to society is more sacred and subtle than theirs, and when I speak of honesty on the part of a dentist I mean something finer than merely giving a dollar's worth of service for a dollar; or paying bills when they fall due. * * * Human nature is so selfish in its tendencies that most of us have to make ourselves over in order to always do the really ethical thing."

If ours is to be a life of service, there appear to be two means of rendering that service, or rather, if as a profession we are required to render a great service to the people, then as individuals, there are two avenues by which it may be rendered; one directly to those who come under the individual's care, and secondly, by rendering some service to a fellow dentist, and thus increasing his ability to render service.

In these days of "higher efficiency"—in these days of determined increase of business over the preceding year—we find business pushed to the limit. Tobacco manufacturers have been forced to induce our women and girls to smoke cigarettes—billboards are placarded with signs, "Ask Dad, he knows." Thus the boys, who are forbidden by law to smoke cigarettes, are subtly encouraged to take up the habit. Gum manufacturers advertise, "Buy it by the box." These and numerous others are the crimes of the nation. They are extravagances, brought on and encouraged by commercialism. Commercialism teaches *extravagance;* Professionalism teaches *conservatism.*

Certain manufacturers of equipment useful in a dental office claim that they

can't get a footing in San Francisco, and have sought the services of a dentist to demonstrate before a gathering of dentists. He declined because it would hurt his standing. Immediately then the writer was sought out for an opinion—the opinion given being that for the last two or three years there had not been a single meeting of the local society at which this particular subject had not been mentioned, either directly or indirectly. The argument used was that the men needed or wanted something more directly applied. Now, do we need to be taught by the manufacturer?

Again, we picked up the other day a little private advertising bulletin, and on it we find: "What Koch was to medicine; what Lister was to asepsis; what Edison is to the field of electricity; so is ———— to dentistry." This likewise happened to be a manufacturer.

The answer to the above is that we must pull our literature away from this sort of influence. Our literature is our educational medium, and it must be pure and undefiled, so that thereby a high standard, an ideal, is set up, to which we try to come.

FREE DENTAL CLINIC AT ABERDEEN, S. D.

A free dental clinic has been organized at Aberdeen, S. D., for the purpose of caring for the teeth of children who are unable to pay for dental service. The clinic has been organized by the Aberdeen District Dental Society working in cooperation with Dr. Louis Holtz, City Health Officer, and Miss Lillian Zimpfer, City School Nurse.

The work is to be done at the offices of the various members of the society, the patients being sent by Miss Zimpfer and bearing an appointment card certified by her. For subsequent visits the patient is given an appointment card by the dentist, this card serving as an excuse which the patient can present to the teacher in order to be excused from school for the time necessary for the appointment. A record will be kept of all work done, and such record will form a part of the City Health Officer's annual report.

The following Dentists will have charge of the work. Dr. Carl Fossum, chairman; Dr. T. C. Bonney, secretary; Dr. A. W. Fossum; Dr. M. R. Hopkins; Dr. H. W. Thomas; Dr. G. F. Schweiger; Dr. O. D. Westall; Dr. J. S. Goodmanson; Dr. Harry Wells and Dr. H. F. Stevens.

REMOVE THAT FOOLISH TAX!

Armour & Company draw our attention to editorials that are appearing thru out the country demanding that Congress remove the foolish and costly tax on oleomargarins. One of these, from The Journal of the American Medical Association of January 19, emphasizes the point that increased use of oleomargarins would release much milk and cream for other purposes and would probably mean a material reduction in the price of these commodities.

In our opinion the federal tax on oleomargarin is most foolish and unfair. If the manufacturer colors oleomargarin, he is forced to pay a tax of 10 cents a pound despite the fact that butter may be colored in exactly the same manner without any restriction whatsoever.

The imposition of this tax is simply a tribute which Congress levies in favor of the dairymen. Practically all authorities agree that oleomargarin, even the colored variety, is as wholesome and nutritious as butter, and that it reaches the market in excellent sanitary condition.

Now that the world war is making the food situation serious, we sincerely trust that Congress will no longer tolerate so unjust and unfair an imposition upon the consumer.—*Ohio State Medical Journal.*

REPORT OF TABULATING COMMITTEE OF NATIONAL ASSOCIATION OF DENTAL EXAMINERS.

Mr. President and Members of the National Association of Dental Examiners:

Your Tabulating Committee presents herewith its Eighth Annual report:

Since the New York meeting of the N. A. D. E. we have completed the tabulation of the State Board Secretary's reports, of first examinations for the year 1917. Dr. Friesell, Chairman of the Tabulating Committee of the N. A. D. F. has also tabulated these reports. We met in Pittsburgh and compared results. After making a few minor corrections the two reports are identical and we feel positive that they are accurate. The report having received the audit of Dr. Friesell and myself is declared official.

Reports were received and tabulated from 45 states, Colorado, Idaho, Nevada and Washington did not send in reports. With one exception the same states did not report last year. Last year Idaho reported and Mississippi did not. It seems to be impossible to get reports from California, Nevada and Washington. However, I shall try to get reports from these states in 1918. The reports this year are about on a par with last year's reports. There are several secretaries who do not follow the instructions on back of tabulation sheets, and I would once more urgently request that these simple directions be followed in so far as possible.

The total number of graduates in the United States for the year 1917 was 3,010 (an increase of 93 over 1916.) Of this number 2,485 were examined by the State Boards reported; number passed, 2,146; number failed, 339; percentage of failures, 13.6, showing an improvement of three per cent. over last year.

The total number of graduates for the eight years of tabulation was 17,902; total examined, 14,320; passed, 12,032; failed, 2,288; percentage of failures, 15.9.

The following eight schools had 30 per cent. or more of failures in 1917:

C. of P. & S. (Cal.) Dental Department, 50 per cent.

Georgetown U. Den. Dept., 35.7 per cent.

U. of M. C. of Den. Sur., 31.3 per cent.

C. of Jersey City Den. Dept., 88.8 per cent.

Western Reserve U. School of Dentistry, 51.2 per cent.

Cincinnati C. of D. S., 50 per cent.

State University of Ohio, Den. Dept., 34.1 per cent.

Meharry Dental College, 41.1 per cent.

In an accumulative tabulation the following schools have a percentage of 30 or more of failures:

C. of P. & S. (Cal.), 50 per cent.

Southeastern Dental University, 100 per cent.

Baltimore Med. Col. Den. Dept., 32.8 per cent.

College of Jersey City, Den. Dept., 86.5 per cent.

Cincinnati College of D. S., 31.3 per cent.

Meharry Dental College, 31.3 per cent.

Let me again urge the State Board Secretaries to send in their reports as soon as possible after examinations are completed. Don't fail to send in report of fall or winter examination. If more than one summer examination is held, send separate report for each. If at any time your supply of blanks is exhausted, kindly notify us and supply will be sent immediately. Your Committee wishes once more to extend our personal thanks to each State Board Secretary who sent us a report, and for the many other courtesies we have received in the past. We append herewith reports of 1917 tabulation; also cumulative tabulation for 1910-11-12-13-14-15-16-17.

Respectfully submitted,

T. A. BROADBENT,
Chairman, Tabulating Committee.

RESULTS OF TABULATION OF STATE BOARD REPORTS FOR GRADUATES YEAR 1917.

State	College	Total Number of Graduates	Total Number Examined	Examined Passed	Examined Failed	Percentage of Failures	Number of States Examined in
California	Univ. California College of Dentistry	39					
	Coll. P. & S. Dental Department	68	2	1	1	50	2
	Univ. of So. Cal. College of Dent.	57	5	5			3
Colorado	Colorado College Dental Surgery	44	42	41	1	2.3	5
Dist. Columbia	Howard Univ. Dental School	36	10	8	2	20	8
	Georgetown Univ. Dental Dept.	26	14	9	5	35.7	3
	Geo. Washington Univ. Dept. of Dent.	25	9	8	1	11.1	3
Georgia	Southern Dental College	50	50	50			3
	Atlanta Dental College	59	59	58	1	1.6	7
Illinois	Chicago College Dental Surgery	144	121	115	6	4.9	11
	Northwestern Univ. Dental School	134	112	104	8	7.1	15
	Univ. Illinois College of Dentistry	38	30	30			4
Indiana	Indiana Dental College	62	62	62			4
Iowa	Univ. Iowa College Dentistry	81	77	73	4	5.1	3
Kentucky	Louisville College of Dentistry	71	57	49	8	14.	10
Louisiana	Loyola Univ. College of Dentistry	9	7	7			1
	Tulane Univ. Dental Department	11	11	11			2
Maryland	Baltimore College Dental Surgery	62	56	40	16	28.5	12
	Univ. Maryland Dental Department	46	42	33	9	21.4	5
Massachusetts	Tufts College Dental School	118	108	104	4	3.7	5
	Harvard Univ. Dental School	45	35	30	5	14.2	3
Michigan	Univ. Michigan College Dental Surg.	93	83	57	26	31.3	4
Minnesota	Univ. Minnesota College of Dentistry	90	86	84	2	2.3	3
Missouri	Kansas City Dental College	67	62	60	2	3.2	6
	Washington Univ. Dental Dept.	40	38	36	2	5.2	5
	Western Dental College	54	51	46	5	9.8	6
	St. Louis Univ. School of Dentistry	74	66	66			6
Nebraska	Univ. of Nebr. Lincoln Dental Coll.	35	33	33			1
	Creighton Univ. College Dentistry	22	21	20	1	4.7	4
New Jersey	College of Jersey City, Dental Dept.	31	27	3	24	88.8	1
New York	New York College of Dentistry	223	202	157	45	22.2	2
	Univ. Buffalo Dental Dept.	60	52	43	9	17.3	1
	College Dental & Oral Surg of N. Y.	198	179	145	34	18.9	3
Ohio	Ohio College Dental Surgery	34	25	19	6	24.	5
	Western Reserve Univ. School of Dent.	38	37	18	19	51.3	1
	Cincinnati College Dental Surgery	18	16	8	8	50.	4
	State Univ. Ohio Dental Department	43	41	27	14	34.1	1
Oregon	No. Pacific College of Dentistry	93	50	38	12	24.	2
Pennsylvania	Philadelphia Dental College	83	65	52	13	20.	5
	Univ. of Pittsburgh School of Dent.	84	82	82			2
	Univ. Pennsylvania School of Dent.	219	196	166	30	15.3	12
Tennessee	Vanderbilt Univ. School of Dentistry	33	32	32			8
	Univ. Tennessee Dental Department	9	9	8	1	11.1	2
	Meharry Dental College	21	17	10	7	41.1	9
Texas	State Dental College	33	19	15	4	21.	3
	Texas Dental College	9	6	6			1
Virginia	Medical Coll. Virginia School of Dent.	22	22	21	1	4.5	2
Wisconsin	Marquette Univ. Dental School	59	59	56	3	5.	3
		3010	2485	2146	339	13.6	

SUMMARY.

Number of State Board Reports Received	45
Number of State Board Reports Tabulated	45
Total Number of Applicants Examined and Passed	2146
Total Number of Applicants Examined and Failed	339
Percentage of Failures	13.6

CUMULATIVE RESULTS OF TABULATING STATE BOARD REPORTS FOR GRADUATES YEARS 1910-11-12-13-14-15-16-17

State	College	Total Number of Graduates	Total Number Examined	Examined Passed	Examined Failed	Percentage of Failures	Number of States Examined In
Alabama	Birmingham Dental College	54	50	38	12	24	1
California	Univ. California Coll. of Dentistry	171	1	1			1
	Cal. P. & S. Dental Department	259	2	1	1	50.	2
	Univ. So. Cal. College of Dentistry	288	17	17			5
Colorado	Colorado College Dental Surgery	251	235	218	17	7.2	12
Dist. Columbia	Howard University Dental School	212	69	57	12	17.3	26
	Georgetown Univ. Dental Dept.	212	160	129	31	19.3	23
	Geo. Washington Univ. Dept. of Dent.	108	79	68	11	13.9	7
Georgia	Southern Dental College	362	337	303	34	10	10
	Atlanta Dental College	472	441	367	74	16.7	15
	Southeastern Dental University	2	2		2	100	2
Illinois	Chicago College Dental Surgery	961	805	633	172	21.3	24
	Northwestern Univ. Dental School	1046	824	691	133	16.1	30
	Univer. Illinois College of Dentistry	216	197	166	31	15.7	16
Indiana	Indiana Dental College	406	387	354	33	8.5	17
Iowa	Univer. Iowa College of Dentistry	416	388	362	26	6.7	12
Kentucky	Louisville College of Dentistry	361	301	264	37	12.2	24
Louisiana	Louisiana State College Dental Surg.	6					
	Loyola Dental College	15	11	11			2
	Tulane Univ. Dental Dept.	148	109	97	12	11	4
Maryland	Baltimore College Dental Surgery	445	298	210	88	29.5	20
	Univer. Maryland Dept.	421	320	230	90	28.1	22
	Baltimore Medical Coll. Dental Dept.	83	64	43	21	32.8	12
Massachusetts	Tufts College Dental School	578	480	449	31	6.4	6
	Harvard Univ. Dental School	307	243	215	28	11.5	8
Michigan	Univ. Michigan College Dental Surg.	582	517	477	40	7.7	15
Minnesota	Univ. Minnesota College Dentistry	534	495	460	35	7	7
Missouri	Kansas City Dental College	355	315	290	25	7.9	14
	Washington University Dental Dept.	246	232	223	9	3.8	9
	Western Dental College	327	287	258	29	10.1	16
	St. Louis Univ. School Dent.	399	362	338	24	6.6	17
	National Univ. Arts and Sciences..)	82	70	55	15	21.4	5
	Barnes School of Dentistry)						
Nebraska	Univ. of Nebr. Lincoln Dental Coll.	122	117	117			1
	Creighton Univ. Coll. of Dentistry	186	177	172	5	2.8	5
New Jersey	College of Jersey City Dent. Dept.	57	52	7	45	86.5	1
New York	New York College of Dentistry	1065	935	676	259	27.7	5
	Univ. Buffalo Dental Dept.	309	278	213	65	23.3	4
	College Dent. & Oral Surgery	612	561	409	152	27	4
Ohio	Ohio State Univ. Dept. of Dentistry	290	283	258	25	8.8	5
	Western Reserve Univ. School of Dent.	250	241	180	61	25.3	4
	Cincinnati College Dental Surgery	117	99	68	31	31.3	8
	Ohio College of Dental Surgery	316	264	196	68	257	15
Oregon	No. Pacific College of Dentistry	434	292	244	48	16.4	8
Pennsylvania	Philadelphia Dental College	374	250	206	44	17.6	16
	Univer. Pittsburg School of Dent.	413	401	382	19	4.7	8
	Univ. Pennsylvania School of Dent.	1307	824	671	153	18.5	24
	Med. Chi. College Dental Dept.	348	248	176	72	29	9
Tennessee	Vanderbilt Univ. School of Dentistry.	290	269	254	15	5.5	17
	Univ. Tennessee Dept. Dentistry	91	85	82	3	3.5	5
	Univ. Memphis Dental Dept.	5	4	4			3
	Meharry Dental College	203	166	114	52	31.3	20
	Univ. W. Tennessee Coll. Dent. Surg.	3	1	1			1
Texas	State Dental College	163	106	85	21	19.8	6
	Texas Dental College	105	76	59	17	22.3	1
Virginia	Univ. Coll. Med. Dental Dept.	32	30	23	7	23.3	2
	Med. Coll. Virginia School Dentistry	88	80	63	17	21.2	6
Wisconsin	Marquette Univ. Dept. Dentistry	348	337	303	34	10	7
	Wisconsin Coll. P. & S. Dept. Dent.	17	17	15	2	11.7	1
		17902	14320	12032	2288	15.9	
Canada	Royal Coll. Dental Surgery, Ontario	341					
	Laval Univ. School of Dentistry	138					
	McGill Univ. Dept. Dentistry	28					
	Dalhousie Univ. Faculty Dent.	14					
		18423					

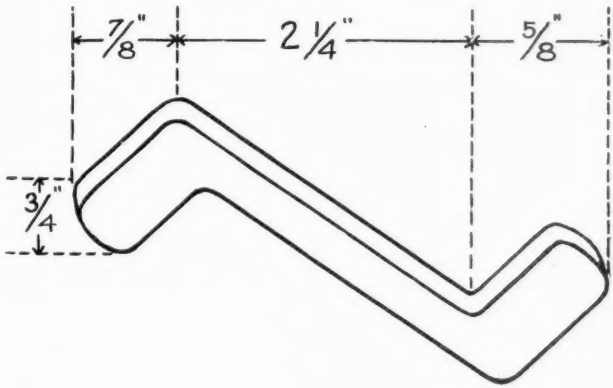
SUMMARY.

Total Number of Applicants Examined and Passed	12,032
Total Number of Applicants Examined and Failed	2,288
Percentage of Failures	15.9

DENTAL PLATE HOLDER.

By A. N. Bessesen, M. D., Minneapolis, Minnesota.

Good radiographs of dental cases can be made only when the dental film is held firmly and steadily in proper position, and then the exposure should be such that the shadow of the part desired will fall on the center of the film. To accomplish this, various devices have been made. I am not aware, however, of any such devise more simple, and perhaps satisfactory, than the one I wish hereby to submit. It has been tried out on several hundred cases and has failed in only a very few, such as very nervous patients or should the patient lack a few teeth and so fail to grasp the holder properly when it would be found necessary for the patient, or an assistant, to steady the instrument.



It's construction is so simple that an operator can make one or more for his own use. Take a strip of aluminum three-quarters of an inch wide and four inches long, it may be of one-sixteenth or one-eighth inch material. The edges are made smooth and the ends rounded off as may be desired, each end is then bent as shown by the accompanying illustration until about one hundred and ten degrees with the shaft of the instrument. The shaft should be two and one-quarter inches long and if roughened or corrugated will be held more firmly by the teeth of the patient. I have found that when made of smooth material there is some tendency for the holder to creep or move slightly should the patient be of a nervous temperament. The bent parts at each end I shall call blades, the one should be five eighths of an inch long the other one seven-eighths of an inch long so as to accomodate the various irregularities of the upper and lower jaw in different patients. These blades are bent toward opposite sides so as not to interfere with the Roentgen ray. Both are to be in parallel planes so that when the instrument is in use the exposed blade will indicate the position of the dental film as it is held in place against the inner side of the jaw by the opposite blade. It is necessary that the blades be bent at an obtuse angle with the shaft to confirm with the inner surface of the

jaw of the patient and thus draw into closer apposition the dental film when in place. By this arrangement the film is held firmly in proper position by the simple act of the patient setting the teeth together on the shank of the holder.

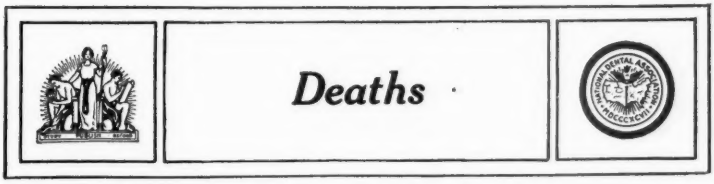
With this holder one does away with the awkwardness of holding the film in place and it saves unnecessary exposure for both the patient and assistant. It is automatic in its action once the film is in place with the patient's jaws clamped on the holder it is held firmly and the exposed blade clearly indicates the position of the film.

THE DENTAL SOCIETY.

"Training is everything. The peach was once a bitter almond; cauliflower is nothing but cabbage with a college education."

We were born into this world whether we wanted to be or not. We had no choice in the matter; or at least most of us did not. We spent our boyhood days in the way most boys do—or at least most of us did. Then came our school days whether we wanted to go to school or not. Finally we reached that stage where we had to decide what our future vocation was to be. We chose dentistry and entered a dental college. We entered a dental college to study dentistry—to become dentists; to learn how. After finishing the required course we enter upon the practice of dentistry. Look back upon those courses, those methods and what was known then and compare that knowledge and those methods with what you know today and the methods you now have. Don't they look crude? What has brought about that change? What is the underlying force that is constantly carrying the profession forward, developing and improving it? Is it the teachers in the dental college? They could not do it. Not enough of them. Is it the manufacturers? They help but all these new ideas could not come from them because they are not in close enough touch with the needs of the profession, nor do they have the proper view point to it. It is the dentists themselves. They are the ones who have improved the methods and unfold the great underlying principles of dentistry as we understand them today. And how have they done it? By what means have all these changes been brought about? There is but one answer: the dental societies. The dental society is the means of advancement of the profession. It is the mother of all new ideas, all new methods. Where would dentistry be today had it not been for the society? The dental society is to the practitioner what the college was to you when you first decided to study dentistry. Where would dentistry be today were it not for the dental colleges and in what condition would these colleges be in, were it not for the societies?

You chose dentistry because you wanted to, and you received a dental education in a dental college, seeing the need for better trained men, organized the society, started colleges, fostered and developed them until they have taken their rightful place among the educational institutions of the world. This same society, which made possible your education can continue to develop you if you so desire. A dental education does not end with the end of the college course,—it only begins there. Join the organization that made possible the education you received in college. Support it and attend all its meetings. Don't let your education cease at the starting point.—*Michigan Dental Journal.*



Dr. J. W. Parsons, of Huntington, W. Va. His death came as a sad blow to the members of the profession in West Virginia, as well as many other states.

Dr. Parsons was secretary of the West Virginia State Dental Society, having held this position for three years, his work for the society cannot be too highly praised.

Dr. Parsons had the ability to do things right as well as doing them quickly and the roster of the state society looked to him for guidance.

He alone without doubt, was responsible for the present good fellowship which exists among the profession in West Virginia.

At the time of his death he was giving a great part of his valuable time to the work of the state meeting, which is to be held in April at Huntington.

The whole state of West Virginia feels that they have lost their main cog of dental advancement, as well as one who had proven to be a true personal friend to all who knew him.

Dr. Parsons was in his 44th year. He graduated from the University of Pennsylvania in 1898 and immediately located in Cleveland, where he practiced his profession for 6 years. He then moved to Huntington the place of his childhood.

In 1915 he realized the need of an Orthodontist in West Virginia and took up that line of work.

He studied under Dr. Martin Dewey and for the past two years had devoted his entire time to the Orthodontic work.

The deceased leaves a wife and three children, one girl 16 years old and two boys, age 13 and 11. His devoted parents also survive him and their sorrow is made all the more unbearable because of the fact that he was the only child of those noble people.

The funeral was attended by practically all the executive council of the state society.

His dental associates of Huntington acted as pall bearers. Dr. Parsons is gone but his efforts to advance the standard of dentistry in the mountain state will not be in vain for he has planted a seed that will not die.

IN MEMORY OF OUR DEAD.

God in his all wise power has seen fit to remove from our Society, and from the walks of men, Dr. Roscoe L. Cantrell, who was born at Oakville, Ill., July 2, 1885. Dr. Cantrell, was reared on a farm where he grew to manhood, was educated in the public schools of Illinois, but having grown tired of the farm life, he secured a position from the government as R. R. mail clerk, which position he held for a number of years, running from St. Louis to Paragould, Ark., over the Cotton Belt.

Owing to his genial disposition and honesty of purpose, he soon succeeded in having as his friends, every clerk on his run and it was with a degree of sadness when he announced to these boys

that he was to quit the mail service to take up Dentistry. Dr. Cantrell entered the Dental Department of the St. Louis University, Oct. 1, 1910, graduating with the class of June 1, 1913. It was the happy privilege of the writer to have been a class mate of Dr. Cantrell thru each year of his course in college, and to say that he was loved and respected by the entire faculty, the members of his fraternity, members of other fraternities, and those outside of the fraternity, is saying little of him, for it was always Dr. Cantrell who was playing the game square, not only while in college, but in every walk of life. His open countenance was convincing that he was truly, "A friend of men."

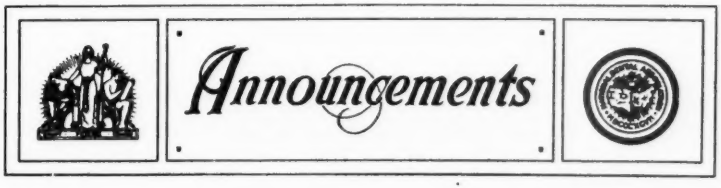
Dr. Cantrell, after having graduated, took up the practice of his chosen profession, in the summer of 1913, associating himself with Dr. Gree at Paragould, Ark., where he conducted a large practice until he moved to Brinkley, Ark., where he began practice alone. He only practiced here for a short while until he and Dr. Hudson, of Des, Ark., were out driving and they had the automobile accident in which Dr. Cantrell died in the hospital in Little Rock the following day, Oct. 7, 1916. All was done for him that modern medicine and science could give, but his injuries were too severe, and he answered the call as bravely as he had faced every other obstacle in life.

Death is just as mysterious today as it was 1000 years ago, notwithstanding our ingenuity, our phylosophy, and all our learning, and we can only submit to the Great Architect of the universe whose wisdom we cannot doubt. His remains were laid to rest at Oakville, Ill., his old home.

Dr. Cantrell left a mother, Mrs. T. Cantrell, two brothers, Mr. S. H. Cantrell, of St. Louis, Mr. H. H. Cantrell, of Wichita, Kans., and a sister, Mrs. J. F. Saber, of St. Louis, Mo., and a host of friends who feel his death keenly.

In the death of Dr. Cantrell the N. E. Arkansas Dental Society has lost one of its brightest young members, the Dental profession a useful man, and his mother, sister and brothers a loving son and brother. In honor of his memory, resolved that a copy of this be spread upon the minutes of our Society, and a copy sent to his mother, sister and brothers.

G. C. JERNIGAN.
G. E. STUTTLE.
C. F. SELF.



NATIONAL SOCIETIES.

National Dental Association, Chicago, Aug. 5-6-7-8 and 9.

National Association of Dental Faculties, Chicago, Congress Hotel, Green Room, Aug. 2-3, 1918.

National Association of Dental Examiners, Chicago, 1918.

Xi Psi Phi Fraternity, Chicago, 1918.

Delta Sigma Delta Fraternity—Aug. 5, 1918, Chicago, Congress Hotel.

Psi Omega Fraternity National Alumni Chapter, Chicago, Aug. 5, 1918. Business session, 3 P. M., New Ball Room, Auditorium Hotel. Banquet, 7 P. M., Florentine Banquet Hall, Congress Hotel.

Association of Military Dental Surgeons, Chicago, August 7, 1918.

American Society of Orthodontists, Edgewater Beach Hotel, Chicago, Aug. 1-3, 1918.

STATE SOCIETIES.

July.

Wisconsin—July, Milwaukee.

New Jersey—July, 17-19, Atlantic City.

Porto Rico—July, San Juan.

California—July 8-13, San Francisco.

WEST VIRGINIA STATE BOARD OF DENTAL EXAMINERS.

The annual examination of candidates for West Virginia State license to practice, will be held at Parkersburg, W. Va., June 25, 26 and 27, 1918. Blanks and information will be furnished on application to the undersigned.

H. H. SMALLRIDGE. Secretary.

MEETING OF MONTANA STATE BOARD OF DENTAL EXAMINERS.

The Montana State Board of Dental Examiners will hold a session for examination July 8-9-10-11 at Helena, Montana. Applications should be in the hands of the Secretary 15 days before the meeting.

G. A. CHEVIGNY, Sec'y.,
107 Yegen Bank Bldg.,
Butte, Montana.

NEBRASKA BOARD OF DENTAL SECRETARIES.

The next regular meeting of the Nebraska State Board of Dental Examiners will be June 17, 18, 19, 20, 21 at Lincoln, Nebraska.

S. A. ALLEN, Sec'y-Treas.,
Loup City, Nebr.

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS.

The next meeting of the South Dakota State Board of Dental Examiners will be held at Sioux Falls, S. D., beginning promptly at 9 o'clock Monday morning, July 1st, 1918.

All applications must be in the hands of the Secretary by June 24th. Fee for examination, $25. No reciprocity or interchange. Full information and application blanks may be received by addressing, L. S. SPENCER, Sec'y,
Watertown, So. Dak.

BOARD OF DENTAL EXAMINERS STATE OF WYOMING.

The Wyoming Board of Dental Examiners will meet at Cheyenne, Wyo., on the 25th, 26th and 27th of June, 1918, to examine applicants to practice in this state. Further information and application blanks, address

PETER APPEL, Jr.,
Cheyenne, Wyoming, P. O. Box 643.

MAINE BOARD OF DENTAL EXAMINERS.

The Maine Board of Dental Examiners will hold their regular examination beginning July 1st at 8:30 A. M. at the State House.

All applications and fees of $20.00 must be in the hands of the Secretary by June 21st.

The examination for Dental Hygienists will be given at the same time, fee $10.00. Write for application and other information.

WILL S. PAYSON, Secretary,
Castine, Maine.

SOUTH CAROLINA STATE BOARD.

The annual meeting of the Board of Dental Examiners in the State of South Carolina will be held at The Jefferson, Columbia, S. C., beginning promptly at 9 o'clock Monday morning, June 24th, 1918.

All applications must be in the hands of the Secretary by June 14th. Application blanks and full information may be obtained by addressing

R. L. SPENCER, Sec'y,
Bennettsville, S. C.

BOARD OF DENTAL EXAMINERS OF THE DISTRICT OF COLUMBIA.

The Board of Dental Examiners of the District of Columbia will hold the next examination June 24, 25, 26, 27, 1918. Information regarding same may be had by addressing W. M. Simkins, Secretary, 720 Woodward Bldg., Washington, D. C.

W. M. SIMKINS, Secretary.

UTAH STATE DENTAL SOCIETY.

The next annual meeting of the Utah State Dental Society will be held at the Hotel Utah, Salt Lake City, Utah, June 19 to 22, inclusive.

E. C. FAIRWEATHER, Secretary
Salt Lake City, Utah.

CALIFORNIA STATE MEETING.

The California State Dental Association will hold its regular Annual Session for the year 1918 in San Francisco, July 8-13.

We will conduct our meeting this year on the Oklahoma Plan, and feel that we can assure all who attend a pleasant as well as a profitable meeting.

Further information may be obtained by addressing the Secretary: Dr. John E. Gurley, 350 Post St., San Francisco.

THE AMERICAN ACADEMY OF ORAL PROPHYLAXIS AND PERIODONTOLOGY.

The next annual meeting of The American Academy of Oral Prophylaxis and Periodontology will be held in Chicago, August 2 and 3, 1918.

GRACE ROGERS SPALDING, Sec'y.,
803 Empire Bldg., Detroit, Mich.

NOTICE.

The Eighteenth annual meeting of the American Society of Orthodontists will be held August 1, 2 and 3, at the Edgewater Beach Hotel, Chicago, Ill.

This will be an excellent meeting.

It is advisable to make your reservations early.

F. M. CASTO, M. D., D. D. S.,
Secretary-Treasurer,
458 Rose Bldg., Cleveland, Ohio.

National Dental Association

SIXTIETH ANNIVERSARY OF ORGANIZED DENTISTRY and DEDICATION OF BLACK MEMORIAL

will be celebrated August 5-9, 1918, by rendering an unusual literary and clinical program at the Auditorium and Congress Hotels, Chicago, Illinois.

HOUSE OF DELEGATES---MONDAY, AUGUST 5.

The Registration office for this great meeting will be open Monday morning at 8:30. The delegates to the House of Delegates will present their credentials and be seated at 10 A. M. This will be the big official business day of the meeting.

SEMINAR---THE MANAGEMENT OF PULPLESS TEETH---TUESDAY, AUGUST 6, 9:30 A. M.

Six of the best known scientific research authorities will submit "evidence and not opinions" on this subject.

THREE SECTION MEETINGS---TUESDAY, AUGUST 6, 2:00 P. M.

The Section on Prosthetic Dentistry and Crown and Bridge Work will render a program on "Occlusion and Variable Occlusion" and "A Scientific Technic in the Construction of an Artificial Denture."

The Section on Oral Surgery and Anesthesia will present a program on "Cleft Palate and Harelip Procedures" and "Recent Progress in the Management of War Injuries of the Face and Jaws."

The Section on Orthodontia and Periodontia have arranged for the following program:

"A Classification of Pathological Conditions of the Mouth."

"Physiological Factors as Related to the Peridental Membrane, Cementum and Bone in Tooth Movement."

"Orthodontic Appliances and Gingival Tissue."

"The Histology and Development of Cementum."

"The Duty and Responsibilites of the Orthodontist in the Present War."

"The Necessity for Orthodontic Interference in Malocclusion of the Teeth."

MILITARY DENTISTRY---WAR SURGERY---TUESDAY, 8:30 P. M.

The speakers at this session will be surgeons of National and International reputation.

UNUSUAL SECTION PROGRAMS---SIX SECTIONS AND ORAL SURGERY CLINICS---WEDNESDAY, AUGUST 7.

9:00 A. M.

The Sections on Operative Dentistry, Materia Medica and Therapeutics—Organization, Mouth Hygiene and Public Service—Research—The Preparedness League of American Dentists and General Oral Surgery Clinics will each present their programs in various rooms in the Auditorium and Congress Hotels.

2:00 P. M.

The Sections on Prosthetic Dentistry and Crown and Bridge Work—Oral Surgery and Anesthesia and Orthodontia and Periodontia will hold their second session Wednesday, at 2:00 P. M.

CANADIAN DENTISTS, OUR GUESTS---WEDNESDAY, AUGUST 7, 8:00 P. M.

How fitting it is, when the young men of the allied countries are freely and willingly giving their lives in the terrible conflict which is absorbing the attention of the entire world, when men and women of every station in life are making their first business the winning of the War, that the dentists of Canada and the United States should unite in holding their National meetings. The Canadian Dental Association will be the guests of the National Dental Association at this meeting and the program for the Third General Session for Wednesday evening will be furnished entirely by this Society. In the United States we have long since learned to follow the advice of Ruskin when he said

"Gain all the knowledge you can;
Then use it for the highest purpose."

INTERNATIONAL GENERAL CLINIC---150 CLINICIANS---THURSDAY, AUGUST 8, 9:00 A. M.

Clinics will be given by members of the Canadian Dental Association, representatives of forty states, and Alaska—Unit Clinics, Special Clinics on Root Canal and Crown and Bridge Work.

LUNCHEON TO OUR EX-PRESIDENTS.

Former Presidents of the American, Southern and National Association to be the guests of the Association at a luncheon in their honor by the members of the profession, who desire in this small way to show their appreciation of the valuable services they have rendered the profession and also to pay a just tribute to the Founders and Builders of Organized Dentistry.

DEDICATION OF THE BLACK MEMORIAL MONUMENT---THURSDAY, AUGUST 8, 2:00 P. M.

It has now been almost three years since the dental profession was deeply grieved to hear of the death of Doctor G. V. Black. Those who were present at the Panama Pacific Dental Congress at San Francisco will never forget, when his death was announced just at the opening of the Congress, how the cloud spread over that vast audience. In matters pertaining to Dentistry, Dr. Black was easily the master. If the world misses him, as it surely does, how much more do we miss him? It was our pleasure and privilege to live with him, speak to him and feel free to consult him at any and all times. By his death, the dental profession has lost one of its most cherished members; the world has lost a benefactor. All that was needed to erect a monument to his memory was for some one to say the word. That word has been said, and dentists from nearly every state in the Union, as well as from many foreign countries, have contributed to the fund for the purpose. What could be more appropriate, therefore, than to unveil the monument to this great man when the National Dental Association is holding its annual meeting in the city, where, during the last years of his life, he lived and worked.

PATRIOTIC SERVICE---THURSDAY, AUGUST 8, 8:00 P. M.

Men of International and National reputation will be on the program for this unusual meeting, men who are the recognized leading statesmen, surgeons and divines of this age. It is quite fitting in this great war crisis that the dental profession should show its patriotic spirit by pledging anew its loyalty and devotion to our country. The speakers on this occasion will give the members of the dental profession an opportunity to hear the best men of the day discuss the vital problems that have to do with the present and future of our Republic.

GENERAL SESSION AND SECTION MEETINGS---FRIDAY, AUGUST 9, 9:00 A. M.

The Sections on Operative Dentistry, Materia Medica and Therapeutics, Organization, Mouth Hygiene and Public Service, Research, and the House of Delegates and the last general session will be the climax of this great meeting—an anniversary meeting that will go down through the years as having established a new high water mark in the history of dentistry.

REMEMBER THE SPLENDID TIME YOU HAD IN CHICAGO

at the Fifteenth anniversary celebration of the Chicago Odontographic Society in 1903 and the Golden Anniversary of the Illinois State Dental Society in 1914. Since these meetings, several years have elapsed and the Chicago dentists have profited by being hosts on these occasions. They now ask that we give them another opportunity to prove the foregoing assertion.

PSI OMEGA FRATERNITY.

The National Alumni Chapter of the Psi Omega Fraternity has established headquarters during the National Dental meeting at Room 230, Auditorium Hotel.

The business session of the National Alumni Chapter will be held Monday, August 5th, at 3:00 p. m.

The Psi Omega banquet will be held in the Florentine Room of the Congress Hotel at 7:00 P. M., Monday, August 5th.

Psi Omegas who expect to attend the banquet should communicate at once with Dr. M. M. Printz, 4235 Lake Park Ave., Chicago.

TUFTS COLLEGE DENTAL SCHOOL.

Boston, Mass., April 30, 1918.

Dear Editor:—

On account of the extravagant statements in the newspapers in regard to the seriousness of the fire which caused considerable damage to the building occupied by the Tufts College Dental School, I feel that the following admirable statement published as an editorial in the Boston Transcript of April 29th, might properly be given space in your next issue as an item of news interesting to the profession. As a matter of fact, even our clinical facilities have not been seriously crippled and we were able to carry on uninterruptedly our work in all departments.

We have been in a measure repaid for our loss by the generous spirit shown by our sister school of Harvard University thru Dean Smith, and also by a kindly offer from President Merlin, of Boston University, both extending to us the use of their buildings and facilities, should we require them. This broad attitude and genuine professional spirit I am very glad to acknowledge.

Very truly yours,

WILLIAM PRICE, D. M. D., Dean.

The Tufts Dental School.

It is good to know that the damage done the Tufts Dental School by yesterday's fire is less serious than this morning's reports seemed to indicate. In all probability the institution has suffered no positive crippling. The flames did especially attack that part of the medical school plant which is given over to dentistry, but they do not appear to have laid all of it low by any means. When accounts were cast up this morning it was seen to be only the dental clinic that was thoroly wrecked, while other principal facilities of the school were left in a condition that can be quite quickly repaired. Barring only the occurrence of rain during the day, causing water damage before the exposed equipment can be brought under cover, Tufts will be able to continue this department under very nearly its normal conditions.

PREPAREDNESS LEAGUE OF AMERICAN DENTISTS.

NOTES AND NEWS.

Communication from the President.

Who should receive the services of the members of the League? Every worthy man within the draft age weather he may or may not be in the service of his country at the time.

Let us forget all but the one thought—that we must do our utmost to help strengthen our great National Army. We must help make fighters to protest our flag and we must do it NOW. Tomorrow may be too late.

One of our members recently arose at 3 A. M. and worked until 5 that one of "our boys" might go away in comfort. It is noble work and thousands of instances similar to this one might be related. The pride we feel in the way our profession is meeting the crisis cannot be expressed in mere words.

Every man you make dentally fit will fight for you in France.

HAVE AN ARMY OF YOUR OWN.

All League Service Must be Free.

It is well, perhaps, at this time to remind our members that all dental service

rendered in the name of the League must be free. There can be no deviation from this rule without nullifying the great principle upon which our organization is founded.

We are rendering an inestimable service to our country and when we shall have completed our work, let it be said that we gave freely, gladly and with true patriotic spirit.

Third Annual Meeting of the League.

Our third annual meeting will be held on August 7th, in conjunction with the National Dental Association, Chicago, Ill.

We are arranging a program which will be of absorbing interest and urge every member who belongs to the N. D. A. to join us in the enjoyment of the good things we are preparing.

J. W. BEACH.

* * *

Communication from the Director General.

Regarding the editorial* which was enclosed with the letters you sent me to read, would say that it looks very much like German Propaganda, altho I presume it was printed in all innocence, but if the editor had stopped awhile to consider it, undoubtedly he would have adopted another form of criticism.

The Preparedness League is working under the supervision of the Surgeon-General's Office. That being the case, one must realize that before this Questionnaire was made up, very serious consideration was given the form of the questions, and each question was devised for a specific purpose. The general purpose of all questions is to help us in securing new members for the Preparedness League in order that the work may be increased to such an extent that the League may be of more efficient help to the Government.

The Question of Charging for Service.

Regarding the matter of paying for dental service by those who are well able to pay. A dentist is asked to give but one hour a day to the registrants. He would, therefore, be giving but one hour of free dental service whether the man could pay or not, and this surely is not a great hardship on anyone. If the Registrant pays for the service, then directly it ceases to be voluntary service on the part of the dentist, and is therefore, not Preparedness League work. There is no objection to a man who is able to pay for the work, going to his own dentist to have the work done and pay for it, but such service should not be recorded as Free Dental Service or as Preparedness League work, as it is work done strictly in a private capacity and is in no way connected with volunteer service. On the other hand, if any Registrant, however well able to pay, is willing to accept free service at the hands of the Preparedness League, it seems very little for the League to take care of him in comparison with the man offering his life for our protection, and I should dislike very much to hear that any dentist would refuse volunteer service under these circumstances.

Continuous Appointments Not Practicable.

Making appointments with individual members of the drafted men, is, I think, not practicable for the reason that it is only thru organized channels that the dentists offering their services, can be assigned their fair proportion of the work. If work was continued on each mouth until it was put in good condition, it would work out to the advantage of the few and the disadvantage of the many. If a Registrant needs a second or third appointment to make his mouth dentally fit, refer him back to the League's Headquarters for such appointments, and if time permits, there is no doubt but that he will be taken care of; meanwhile, those who come after him are not being neglected.

On the other hand, if a Registrant requires a second or third appointment and the dental operator is interested enough

*Editorial from a Western newspaper in which the "Questionnaire," asking dentists to join the League, was criticized.—Ed.

in his case to finish the work, then additional appointments may be made with the Registrant providing they do not interfere with the time he has already pledged the League. In other words, only one hour is to be given each Registrant unless other provision has been made for him either by the dental operator or by the Preparedness League. The **once over** for each Registrant is the important thing to be borne in mind.

Broken Appointments.

When appointments, either first or second, are not kept, the result, of course, is loss of time. When this happens it is unfortunate and must be considered a part of our personal sacrifice, as there seems to be no way to guard against it. New appointments should not be given those who break their first appointments, but they should be referred back to the League's Headquarters and sent back to the State Director.

CHAS. F. ASH.

* * *

Form 3-C Cards.

Each dentist should chart the operations performed, sign his name and apply the Stickers furnished by each State Director or County Director. If the operator has no Sticker, cross out the name of the Selective on the address side and write Lieut. W. A. Heckard, D. R. C., 50 East 42nd Street, New York City, across the card and mail at once.

Form 18 Card.

When the work on each Registrant is finished it should be recorded on Form 18 Card and when this Form 18 Card is filled up and duly signed it should be dropped in the box and sent back to the State Director. Each Card takes care of itself and records work done to date.

R. OTTOLENGUI,
Director of Publicity.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS.

The next meeting of the North Dakota State Board of Dental Examiners will be held in Fargo July 9th. All applications must be in the hands of the Secretary July 1st. For further information write the Secretary.

W. E. HOCKING, Secretary,
Devils Lake, North Dakota.

COLORADO dental practice for sale. Invoices $750. Price $500. Take part cash, large territory—only one other dentist in entire county. First class town, nearest dentist 22 miles. Modern office. Do cash practice $300.00 per month. High school. Address, 1553 F. V. Kniest, Bee Bldg., Omaha, Nebraska.

NEBRASKA unopposed Dental practice for sale. Price $500. Good complete office. Population 1200. No competition. Address, 1558 care F. V. Kniest, R. P. Bee Bldg., Omaha, Neb., Dental Broker.

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THE RHOTANIUM COMPANY

CUYAHOGA BUILDING CLEVELAND, OHIO

Name and symbol registered as trade marks in U. S. patent office and alloy patents pending.